

20th / 21st / 22nd St NW

Protected Bike Lanes

Final Report

August 12, 2019



20th/21st/22nd St NW Protected Bike Lanes

August 2019

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Executive Summary

The District is projected to grow by nearly 170,000 residents and 200,000 jobs between 2010 and 2040, but it has constrained capacity to accommodate growth in vehicle trips. Part of the vision laid out in the *moveDC Multimodal Long-Range Plan* (moveDC) involves building an interconnected network of comfortable and safe bikeways as a basis to reduce auto trips. Several east-west bikeways currently traverse the areas in and around Downtown. However, there is a large north-south gap in the bicycle network between Dupont Circle and the National Mall. The purpose of this project is to provide a safe environment for people of all ages and abilities biking on 20th Street NW, 21st St NW, or 22nd Street NW. The project seeks to minimize impacts to surface transit, parking, and traffic in accordance with DDOT's approved planning goals for bicycle infrastructure, as defined in moveDC.

The project began in March 2018 with an evaluation of existing conditions and the first public meeting to hear from the community. Ultimately three alternatives were selected for conceptual design and analysis:

- 22nd Street NW: two-way protected bike lane on the east side
- 21st Street NW: two-way protected bike lane on the east side
 - Optional contraflow (northbound) unprotected bike lane on the east side between Florida Avenue and New Hampshire Avenue
- 20th Street NW: two-way protected bike lane on the west side

Each alternative provides a fully protected two-way bikeway. In order to select a recommended alternative, each alternative was analyzed based on safety, bus operations, traffic operations, and parking/curbside impacts. The recommended alternative is a blend of two corridors with two-way protected bike lanes:

- On the west side of the 20th Street corridor, between Connecticut Avenue and F Street
- On the east side of 21st Street between G Street and the National Mall

The two streets would connect by one-way protected bike lanes on G and F Streets (to be designed in the next phase of the project. This recommendation provides a fully protected facility that connects to existing bicycle facilities at R Street, Q Street, New Hampshire Avenue, M Street, and L Street, as well as the National Park Service trails of the National Mall. This blended alternative was ultimately selected because it presented the best case in providing a safe facility with minimal turn conflicts, minimal driveway crossings, little disruption to transit stops and added pedestrian amenities. The impacts to traffic operations under 2040 conditions were considered comparable with the other alternatives. This alternative presented the lowest impact to parking, and specifically to residential parking on the north end of the study area.

Introduction

The District is projected to grow by nearly 170,000 residents and 200,000 jobs between the years 2010 and 2040, but it has constrained capacity to accommodate growth in private auto trips. The residential and employment density is projected to increase within the study area, particularly near George Washington University and Downtown.

The vision laid out in moveDC recommends expanding the system of bike lanes into a comprehensive interconnected network, with a focus on improving comfort and safety. The overarching objective is to provide a robust network to support the continued increase of the bicycle mode share from 4.6% in 2017 to 12% in 2040, which is part of moveDC's overall goal of achieving 75% of all commute trips in the District by non-auto modes.

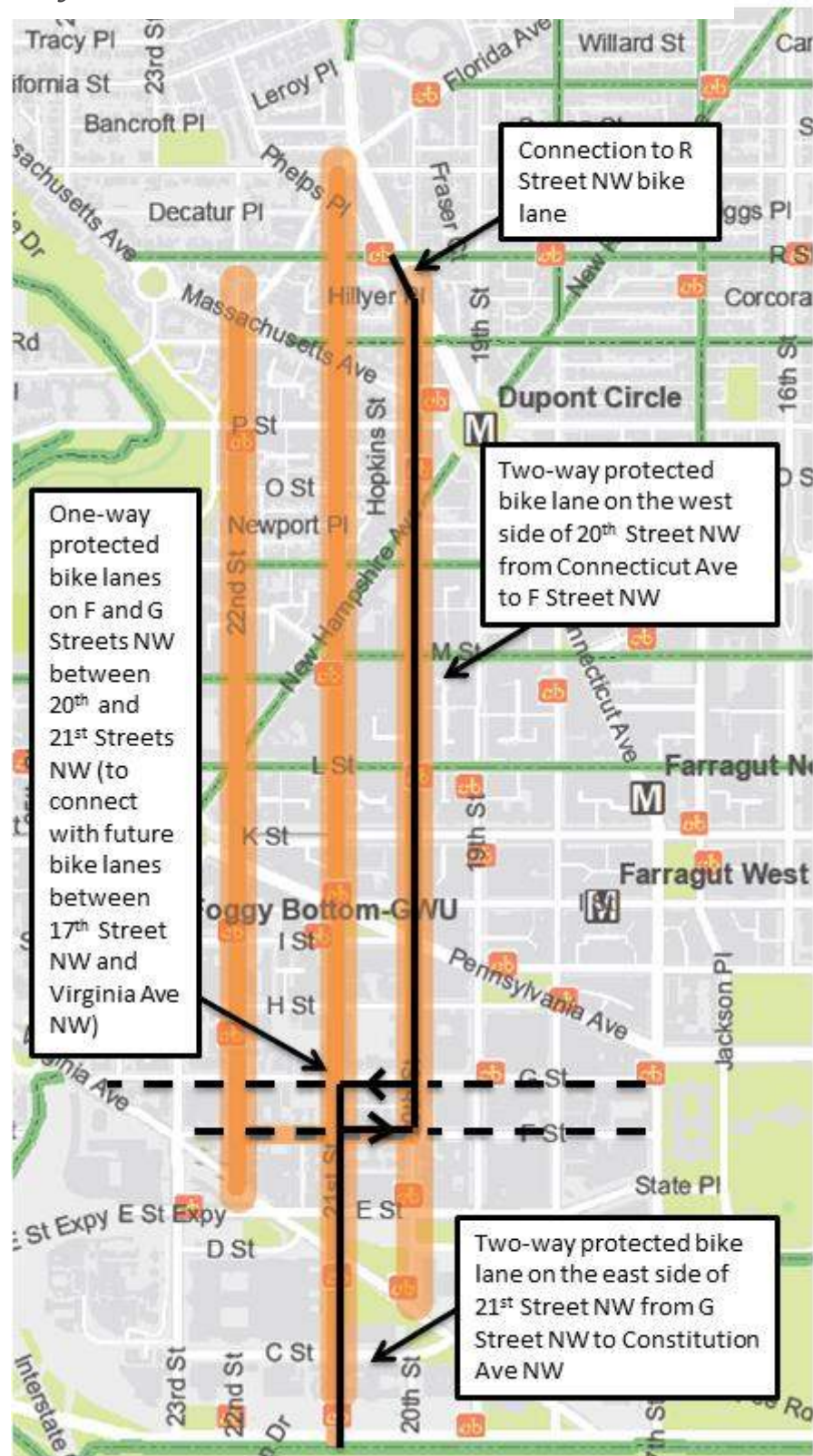
The need for a network of protected bicycle lanes was first conceived in the 2005 Bicycle Master Plan and reiterated in moveDC. Several east-west dedicated bike facilities currently traverse the areas in and around Downtown. However, as shown in the following map, there is a large north-south gap in the bicycle network between Dupont Circle and the National Mall.

The purpose of this project is to provide a safe environment for people of all ages and abilities biking between Dupont Circle and the National Mall. **Figure 1** illustrates the project study corridors. The project further serves to enhance the existing network of cycling infrastructure by connecting existing east-west routes with protected north-south bicycle lanes along the western portion of the Downtown core.

DDOT studies have shown that a majority of cyclists and drivers prefer protected bicycle facilities, where cyclists and vehicles are separated by a raised barrier or parked cars. In an intercept survey for the 15th Street NW protected bike lane, 33 percent of respondents reported an increase in bicycling with the facility in place, and 7 percent of respondents said that they were not previously riding their bike for transportation¹.

¹ 15th Street Separated Bike Lane Pilot Project Interim Results and Next Steps, August 2010

Figure 1: Study Corridors and the Recommended Alternative



As a result of adding 60 miles of bike lanes since 2000, initiation and expansion of Capital Bikeshare, and substantially increasing bike parking, the District has seen bike commuting quadruple over the past 10 years. This growth in cycling trips has demonstrated that there is a latent demand for biking, which can serve a larger population through delivering protected bike lanes that serve all ages and abilities.

People biking and walking are more vulnerable to serious traffic injuries and fatalities. In 2015, DC's Vision Zero initiative identified a concentration of bicycle crashes reported between 2010 and 2014 in the areas around George Washington University and Dupont Circle, indicating that these are difficult locations for people biking in the District. The *2015 DC Vision Zero Action Plan* (Vision Zero) specifically prioritizes protected bike lanes to protect vulnerable users, as well as to deter dangerous parking behavior, such as parking in bicycle lanes.

As part of Vision Zero, this project seeks to build safer streets for all, including bicyclists, pedestrians and drivers. The project seeks to minimize impacts to surface transit, parking, and traffic in accordance with DDOT's approved planning goals for bicycle infrastructure, as defined in the *moveDC Multimodal Long-Range Plan*.

The project began in March 2018 with an evaluation of existing conditions and the first public meeting to introduce the project and receive community input. From there, conceptual plans were developed for three design alternatives. This stage included strategic workshops with interagency partners to discuss solutions for specific design challenges. The three alternatives were presented at a second public meeting to solicit feedback and answer questions. Ultimately a recommended alternative was selected and shared at a final public meeting with the community. **Figure 2** displays the project schedule which is expected to continue into final design and implementation for completion in 2021.



Figure 2: Project Schedule

This document summarizes the process, public outreach, development and evaluation of three alternatives, and selection of a recommended alternative.

Public and Stakeholder Engagement

DDOT actively engaged with the community through large public meetings, attendance at ANC meetings, and focused meetings with key stakeholders to gather feedback, share information, and refine the alternatives. To promote the project, the project team developed a postcard showing the three corridors and directing the public to the project website <https://www.dccycletrack.com/20th21st22ndstnw>. The postcards were distributed during Bike to Work Day (May 17, 2018) at various pit stop locations, especially those within or nearby the project corridors.

Since April 2018, three public meetings sought to update the public on the project's status and to solicit feedback on the design alternatives. The details of these three meetings are summarized in **Table 1** below. To properly notify the public, one week prior to each public meeting, door hangers, shown in **Figure 3**, were placed on residence's doors, community boards, businesses around the George Washington University campus, in the West End Library, and on parked bikes. The project team also reached out to apartment and condominium buildings in the study area and either emailed an electronic copy of the poster or provided door hangers to the main point of contact. The project team contacted ANC commissioners, institutions, interested stakeholders, and cyclists' groups through phone calls, e-mail blasts, and social media accounts.

During all three public meetings attendees provided written comments through the comment form and by placing comments on the roll plots using Post-It notes. Public Meeting #3, which presented the recommended alternative, provided an opportunity for public testimony so that attendees could offer their feedback directly to DDOT staff.

Table 1: Summary of Public Meetings

	Public Meeting #1	Public Meeting #2	Public Meeting #3
Date	Wednesday, May 23, 2018 6pm-8pm	Wednesday, December 5, 2018 6pm-8pm	Saturday, April 13, 2019 10am-1pm
Location	West End Library	West End Library	School Without Walls at Francis Stevens
Purpose	Introduce the project and study area	Present 3 design alternatives	Present the recommended alternative
Attendance ¹	72	72	68
Title VI respondents	49	49	N/A
Comment Period Closed	June 13, 2018	February 13, 2019	May 13, 2019

Notes

¹ based on sign-in

DDOT received over 1,000 public comments since the project inception in April 2018. **Appendix A** includes the final summary reports for each public meeting. A few key observations include:

- 21st Street NW generated the most public comments, both for those in support of and against that alternative.
- Cyclists generally supported a full-length protected bike lane on 21st Street NW.
- Residents concerned with parking loss generally were against 21st Street NW, including the contraflow lane option north of New Hampshire Avenue NW.
- 28% of comments received expressed concern over disruption of the Dupont Circle Farmers Market, urging DDOT to maintain uninterrupted market operations if 20th Street NW is advanced.
- Both ANC 2A and 2B recommended advancing 20th Street NW north of Pennsylvania Avenue NW. ANC 2A recommended advancing 21st Street NW between E Street and Constitution Avenue NW and further studying options for east-west connections between 20th and 21st Streets NW.

Figure 3: Sample Door Hanger



The door hanger features a top section with a photograph of a city street with a protected bike lane, overlaid with a large white circle. Below the photo is a yellow circular logo with a black bicycle icon and arrows. The text "DC PROTECTED BIKE LANES PROJECT" is in bold black. The address "20TH/21ST/22ND STREET NW" and "PUBLIC MEETING #3" are in orange. The event details are on an orange background: "School Without Walls at Francis Stevens", "2425 N Street NW, Washington, DC 20037", "Saturday, April 13, 2019", "10:00am - 1:00pm", "Presentation begins at 10:30am", "Metro Orange/Blue/Silver Line – Foggy Bottom Station", "Metro Bus Routes: 30N, 30S, 31, 33, 38B", and "For additional transportation options, visit www.goDCgo.com". A map shows the project area with orange lines. A circular logo with a bicycle and the text "PROTECTED BIKE LANES" is above the text "20th/21st/22nd ST NW". The text "The District Department of Transportation (DDOT) invites you to a public meeting on Saturday, April 13 to obtain information and provide feedback on the recommended alternative for north- and south-running protected bicycle lanes between Dupont Circle and the National Mall." is in black. The bottom has an orange bar with icons of a person, a bicycle, and a person walking.

DC PROTECTED BIKE LANES PROJECT

20TH/21ST/22ND STREET NW

PUBLIC MEETING #3

School Without Walls at Francis Stevens
2425 N Street NW, Washington, DC 20037

Saturday, April 13, 2019
10:00am - 1:00pm
Presentation begins at 10:30am

Metro Orange/Blue/Silver Line – Foggy Bottom Station
Metro Bus Routes: 30N, 30S, 31, 33, 38B
For additional transportation options, visit www.goDCgo.com

PROTECTED BIKE LANES
20th/21st/22nd ST NW

The District Department of Transportation (DDOT) invites you to a public meeting on Saturday, April 13 to obtain information and provide feedback on the recommended alternative for north- and south-running protected bicycle lanes between Dupont Circle and the National Mall.

Developing Alternatives

Existing Conditions

The project team conducted walk audits for each street in Spring 2018 to identify issues and design constraints. This included an inventory of existing parking restrictions, high volume driveways, roadway widths, and existing bicycle and pedestrian infrastructure. The final concepts show existing conditions side by side with the proposed conditions to ensure an understanding of proposed changes. **Table 2** below summarizes existing conditions for 20th, 21st, and 22nd Streets.

Traffic Analysis

The project team completed an analysis of existing traffic operations to identify current issues in vehicular delay along the corridors. Vehicle, bike, and pedestrian volumes were collected during the AM and PM peak hours at signalized intersections along the three study corridors. The counts were completed between February 2018 and June 2019. No vehicle, bike, or pedestrian counts were completed at unsignalized intersections within the study area. In some cases, older intersection volumes provided by DDOT from 2012 were combined and adjusted with new data to present a full picture of traffic conditions.

Level of Service (LOS) is a qualitative measure describing operational conditions of an intersection or any other transportation facility. It measures the quality of traffic service, and may be determined for intersections, roadway segments, or arterial corridors based on delay, congested speed, volume to capacity (v/c) ratio, or vehicle density by functional class. At intersections, LOS is a letter designation that corresponds to a certain range of roadway operating conditions. The levels of service range from 'A' to 'F', with 'A' indicating the best operating conditions and 'F' indicating the worse, or a failing, operating condition. **Table 3** provides a breakdown of LOS by delay levels, along with different LOS definitions as described in the HCM. The full details and methodology can be found in the *20th/21st/22nd Street – Traffic, Safety & Parking Analyses Memo* in **Appendix B**. Meanwhile, **Table 4** below summarizes the existing traffic conditions measured by vehicle seconds of delay and intersection level of service.

Table 2: Summary of Existing Conditions by Corridor

	22 nd St NW	21 st St NW	20 th St NW
Extents	Massachusetts Ave to F St	Florida Ave to Constitution Ave	Connecticut Ave to E St
Length	10 blocks ~5,140 feet ¹	14 blocks ~7,920 feet	13 blocks ~7,120 feet
Directionality	Northbound Consistent cross-section	Southbound Consistent cross-section	4 varying cross-sections with mixed Northbound and Southbound travel
Connectivity	<ul style="list-style-type: none"> Does not directly connect to National Mall Connects to bike lanes at M St and L St 	<ul style="list-style-type: none"> Directly connects to National Mall Connects to bike lanes at R St, Q St, M St, L St, and New Hampshire Ave 	<ul style="list-style-type: none"> Does not directly connect to National Mall Connects to bike lanes at Q St, M St, L St, and New Hampshire Ave
Key Destinations	<ul style="list-style-type: none"> Marriot Hotel, north of M St NW George Washington University 	<ul style="list-style-type: none"> Phillips Collection George Washington University US Department of State, north of C St Federal Reserve Board, north of C St National Academy of Sciences, south of C St 	<ul style="list-style-type: none"> George Washington University Dupont Farmers Market, north of Massachusetts Ave
Significant Loading Zones		<ul style="list-style-type: none"> Federal Reserve Board, north of C St 	
Design Challenges	<ul style="list-style-type: none"> Florida Ave NW intersection Pennsylvania Ave intersection 	<ul style="list-style-type: none"> Federal Reserve Board Loading Zone, north of C St Pennsylvania Ave intersection 	<ul style="list-style-type: none"> New Hampshire Ave intersection Pennsylvania Ave intersection
Total Parking	214 spaces	355 spaces	216 spaces
Residential Permit Spaces (RPP)	12 spaces	135 spaces	0 spaces
Embassy Spaces	0 spaces	9 spaces	0 spaces
Taxi or Loading	7 spaces	11 spaces	18 spaces
All-Day Metered	32 spaces	40 spaces	41 spaces
AM or PM Peak Restricted	136 spaces	52 spaces	133 spaces
No Parking 7am-6:30pm	39 spaces	108 spaces	24 spaces

Notes:

¹ 22nd St does not extend north of Massachusetts Ave, unlike 21st St and 20th St.

Table 3: Level of Service (LOS) Criteria for Signalized Intersections

Level of Service	Delay (sec/veh)	Description of Traffic Operations
A	0 – 10	Free flow
B	> 10-20	Stable flow (slight delay)
C	> 20-35	Stable flow (acceptable delay)
D	> 35-55	Approaching unstable (tolerable delay)
E	> 55-80	Unstable flow (intolerable delay)
F	> 80	Forced flow (jammed)

A comparison of volumes across the three streets does not identify any overwhelming differences. 21st St does have slightly higher vehicle and pedestrian volumes than either 22nd St or 20th St. The 21st St & M St and 21st St & L St/New Hampshire Ave cluster intersections have particularly high pedestrian volumes creating higher probability for conflicts between vehicles, bicycles, and pedestrians. The following intersections currently operate at LOS E or below:

- 22nd Street NW at L Street NW / New Hampshire Avenue NW (AM and PM)
- 21st Street NW at Constitution Avenue NW (PM)

Table 4: Existing Traffic Operations

Street	AM Peak						PM Peak					
	22 nd St NW		21 st St NW		20 th St NW		22 nd St NW		21 st St NW		20 th St NW	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
Florida Ave NW	46.8 ¹	D ¹	10	A	-	-	45.3 ¹	D	4.9	A	-	-
Massachusetts Ave NW	-	-	11.9	B	12.1	B	-	-	17.3	B	17.9	B
Q St NW	13.2	B	-	-	11.3	B	40.7	D	-	-	22.2	C
P St NW	22.8	C	15.2	B	10.9	B	25	C	13.7	B	13.9	B
N St NW	16.3	B	-	-	6.6	A	26	C	-	-	9	A
M St NW	17.3	B	15.8	B	12.8	B	11.7	B	20.6	C	17.8	B
L St NW	56.5 ²	E ²	16.5	B	11.5	B	81.2 ²	F ²	16	B	16.7	B
New Hampshire Ave NW	-	-	23.9	C	14.1	B	-	-	30	C	13.9	B
K St NW ³	12.1 (WB) 8.1 (EB)	B (WB) A (EB)	15.5	B	11.8	B	25.2 (WB) 10.4 (EB)	C (WB) B (EB)	13.2	B	11.1	B
Pennsylvania Ave NW	17.2	B	26.8	C	12.5	B	22.2	C	15.2	B	21.6	C
I St NW	27.2	C	- ⁴	- ⁴	9.1	A	27	C	- ⁴	- ⁴	13.5	B
H St NW	-	-	7.4	A	9.6	A	-	-	9.8	A	10.6	B
G St NW	16.1	B	7.7	A	6.1	A	17.2	B	8.1	A	10.4	B
F St NW	13.7	B	8.5	A	5.6	A	6.5	A	4.5	A	7.5	A
E St NW	-	-	17.9	B	16.6	B	-	-	16.1	B	22.4	C
Virginia Ave NW	-	-	9.8	A	-	-	-	-	13.7	B	-	-
C St NW	-	-	7.1	A	-	-	-	-	4.4	A	-	-
Constitution Ave NW	-	-	9.9	A	-	-	-	-	93.8	F	-	-

¹ results for 22nd St / Florida Ave / Massachusetts Ave

² results for 22nd St / L St / New Hampshire Ave

³ 22nd St / K St analyzed as two separate intersections due to intersection geometry and signals

⁴ 21st St / I St intersection is unsignalized under existing conditions and was not included in the analysis

Safety Analysis

The project team conducted a safety analysis of 20th Street NW, 21st Street NW, and 22nd Street NW to identify crash patterns and safety issues within the project area. Crash report data obtained from DDOT was summarized by crash type, the number of vehicles involved in the crash, the date and time of the crash, potential crash contributing factors, and weather conditions. The crash data spanned from January 1, 2015 to December 31, 2017. **Table 5** below summarizes the results by street. Full details of the data and methodology are included in the *20th/21st/22nd Street – Traffic, Safety & Parking Analyses Memo* in **Appendix B**.

Table 5: Summary of Safety Analysis

Street	Results
20 th St NW	<ul style="list-style-type: none"> • 36% of crashes were side-swipe crashes • 30% of the crashes occurred during peak hours • 72% of the crashes occurred under clear weather conditions • 82% of the crashes occurred on dry pavement conditions • 81% of the crashes were property damage only crashes • 66% of the crashes occurred under daylight conditions • Between 2015 and 2017: <ul style="list-style-type: none"> ○ Crashes increased by 8% ○ No fatal crashes occurred ○ The number of injury crashes decreased by 19% ○ The number of pedestrian-related crashes decreased by 18%
21 st St NW	<ul style="list-style-type: none"> • 31% of the crashes were side-swipe crashes • 28% of the crashes occurred during peak hours • 75% of the crashes took place under clear weather conditions • 69% of the crashes occurred under daylight conditions • 76% of the crashes were property damage only crashes • 24% of the crashes resulted in injuries • Between 2015 and 2017: <ul style="list-style-type: none"> ○ One fatal crash occurred
22 nd St NW	<ul style="list-style-type: none"> • 37% of the crashes were side-swipe crashes • 31% of the crashes occurred during peak hours • 73% of the crashes occurred during clear weather conditions • 69% of the crashes occurred during daylight conditions • 82% of the crashes were property damage only crashes • 18% of the crashes resulted in injuries • Between 2015 and 2017: <ul style="list-style-type: none"> ○ No fatal crashes occurred

Parking Analysis

The project team completed a parking demand analysis along 20th Street, 21st Street, and 22nd Street using parking meter transaction data provided by DDOT. The data covered morning, midday, and evening periods between January 1st, 2017 and March 31st, 2017. This analysis covers only those blocks with metered parking and does not include blocks with other curb use designations (i.e. – residential permit parking). The team developed a ratio of active parking transactions to the available parking capacity to assess the parking demand at each block during the following weekday time periods:

- Morning: 6:00 AM – 9:00 AM
- Midday: 10:00 AM – 1:00 PM
- Evening: 4:00 PM – 7:00 PM

Analyzing existing parking demand by block helped to understand the potential effect on parking supply of repurposing the curb (parking) lane for a protected bike lane. **Table 6** below summarizes those blocks with parking demand greater than 80 percent. The full details of the analysis are included in the *20th/21st/22nd Street – Traffic, Safety & Parking Analyses Memo* in **Appendix B**.

Table 6: Summary of Heavy Parking Demand by Block

Street	Morning (6AM-9AM)	Midday (10AM-1PM)	Evening (4PM-7PM)
20 th St NW	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • None
21 st St NW	<ul style="list-style-type: none"> • 1400 Block • 1300 Block • 1200 Block • 900 Block East 	<ul style="list-style-type: none"> • 1600 Block • 1400 Block • 1300 Block • 1200 Block • 900 Block • 800 Block • 700 Block • 600 Block • 500 Block 	<ul style="list-style-type: none"> • 1400 Block • 1300 Block • 1200 Block • 900 Block East • 600 Block East • 500 Block East
22 nd St NW	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • 1500 Block • 1000 Block • 900 Block • 800 Block • 700 Block • 600 Block • 500 Block 	<ul style="list-style-type: none"> • 800 Block • 700 Block • 500 Block East

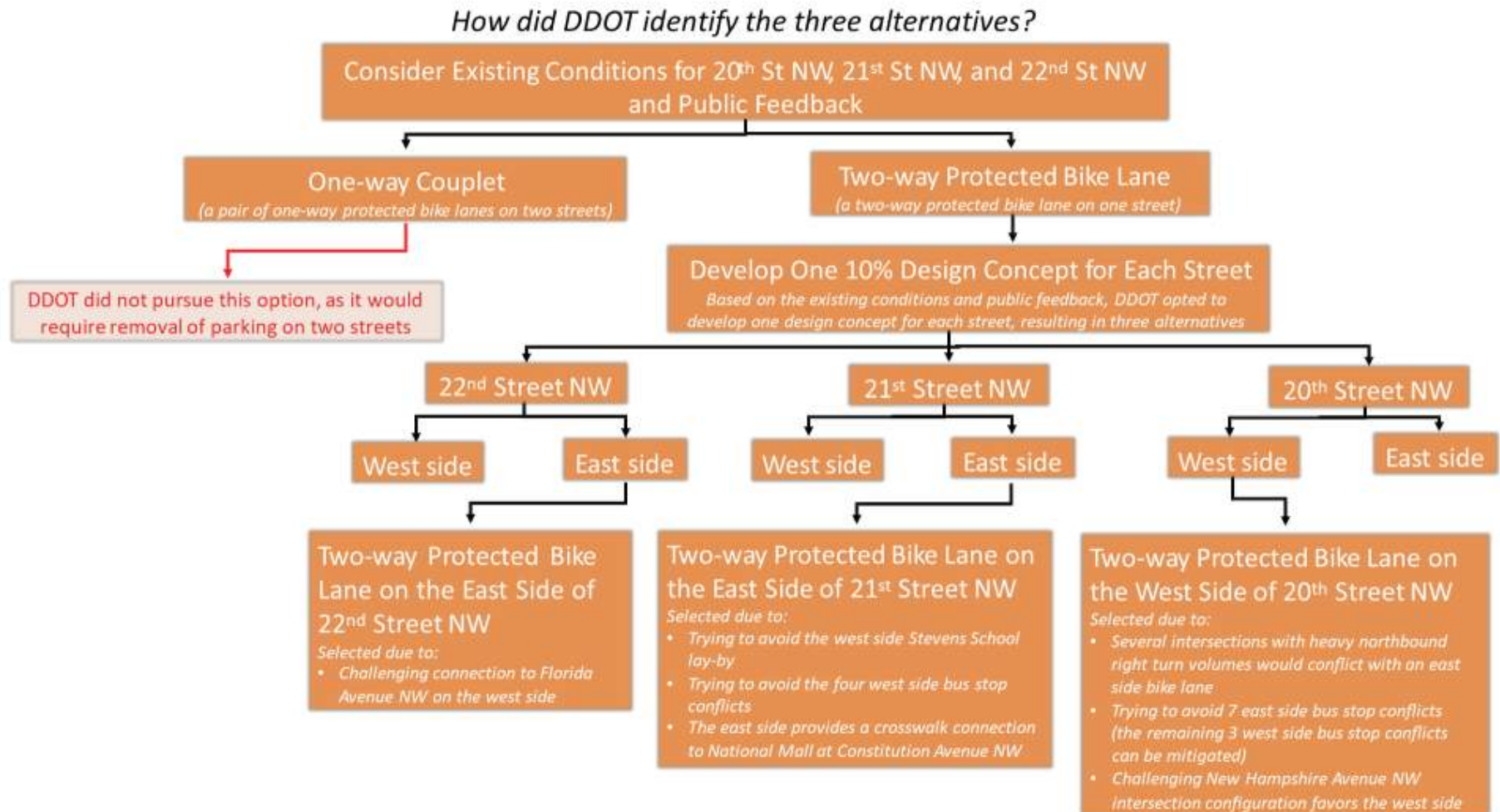
Project Process

The initial list of potential project alternatives included pairs of one-way protected bike lanes on two streets and two-way protected bike lane on each street. Based on the existing conditions and public feedback, particularly around limiting parking impacts, DDOT chose to develop one design concept on each street for a two-way protected bike lane. **Figure 4** below illustrates the details of the facility selection process.

Ultimately, three alternatives were selected for conceptual design and analysis:

- 22nd Street NW: two-way protected bike lane on the east side
- 21st Street NW: two-way protected bike lane on the east side
 - Optional contraflow (northbound) unprotected bike lane between Florida Avenue and New Hampshire Avenue
- 20th Street NW: two-way protected bike lane on the west side

Figure 4: Process to Develop Design Alternatives



Design Approach

The DDOT Design and Engineering Manual defines minimum criteria to be used in the design of all bike lanes in the District. This is illustrated in **Figure 5** below. In the District, protected bike lane buffers are indicated with striping as well as physical barriers. The physical barrier prevents vehicles from crossing the striping and encroaching on the bicycle lane. Two-way protected bicycle lanes are a relatively recent design in the District and thus are not clearly defined in DDOT design standards as it relates to parking setbacks, green bike boxes, two-stage turn queue boxes, and bike signals. As a result, intersection treatments summarized in the following sections were chosen on a technical basis following best practices for intersection design along protected bikeways. The project team relied on guidance from DDOT Traffic Engineering & Signals Division (TESD) and DDOT Transportation Operations & Safety Division (TOSD), as well as external resources to inform the design approach on this project. These resources included the National Association of City Transportation Officials (NACTO) *Urban Bikeway Design Guide*, Federal Highway Administration (FHWA) *Separated Bike Lane Planning and Design Guide*, and the Massachusetts Department of Transportation (MassDOT) *Separated Bike Lane Planning & Design Guide*. This design approach is summarized in **Table 7** below.

With this technical guidance, the project team created roadway cross-sections for each design alternative. In each case, implementing a two-way protected bike lane required removing a parking lane. In some locations this is a travel lane with off-peak parking, and in some places, this is a dedicated parking lane. **Table 8** below details the existing and proposed cross sections by corridor.

Figure 5: Protected Bike Lane Design Elements in the District

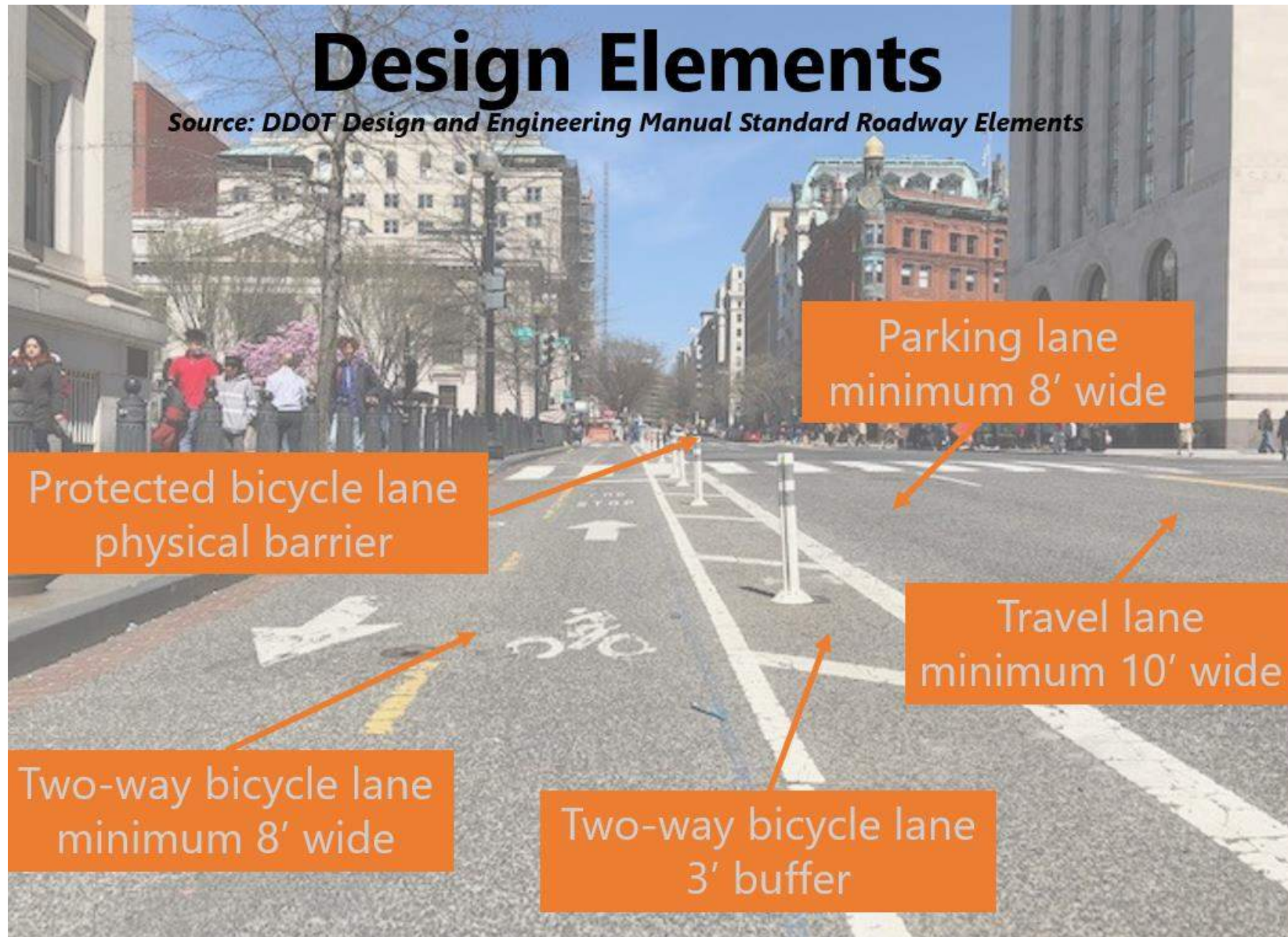


Table 7: Summary of Design Approach

Design Element	Approach	Reference
Left-turn conflicts	Provide protected left-turn phase at all signalized intersections	DDOT TESD
Right-turn conflicts	Provide where AM or PM peak hour right turn volumes exceed 100 vehicles, provide a separate turn lane and signal phase for that movement	MassDOT
Bike boxes	Provide where cyclists turn out of the cycletrack to travel in the direction of vehicle travel; AND Provide where the intersection spacing allows for it	NACTO
Two-stage turn queue box	Provide where cyclists turn out of the cycletrack to travel opposite the direction of vehicle travel; AND Provide where there is full time parking on the side street; AND Provide where the intersection spacing allows for it	NACTO
Parking setbacks	Alleys and driveways should provide 5' setbacks on each side For areas across the street from the proposed bike lane, maintain existing. Bring up to DDOT standard if: An uncontrolled crosswalk, then update approach side; Two-way stop-controlled intersection, then update approach side; Parking protected cycletrack: 10' setback from alleys and driveways; 30' setback from upstream intersection crosswalk	DDOT TESD/TOSD NACTO
Prohibit right-turns on red	Provide where the right-turn on red path would cross a two-stage turn queue box	FHWA
Bike signal	Provide where not in conflict with any simultaneous motor vehicle movement at a signalized intersection, install bike signal. Do not provide where the intersection allows permissive right-turns from the main corridor, use signage indicating bikes should use the pedestrian walk sign for direction and reminding right-turning vehicles to yield.	FHWA

Table 8: Existing and Proposed Cross Sections by Corridor

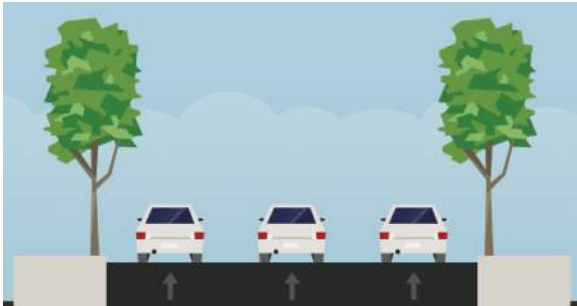
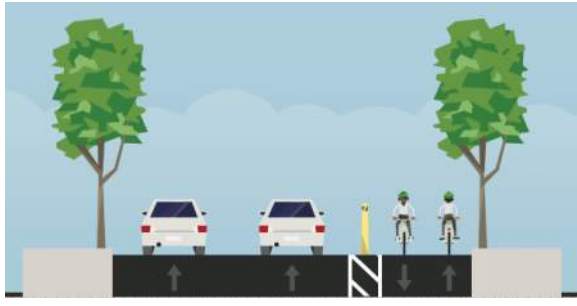


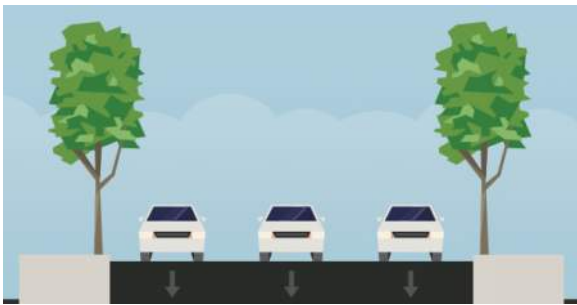

Existing	Proposed
<p>22nd St – consistent cross-section along entire corridor</p> 	<p>22nd St – consistent cross-section along entire corridor</p> 
<p>21st St – North of New Hampshire Ave NW</p> 	<p>21st St – North of New Hampshire Ave NW</p> 
<p>21st St – Between New Hampshire Ave NW and Pennsylvania Ave NW</p> 	<p>21st St – South of New Hampshire Ave NW</p> 

Table 8: Existing and Proposed Cross Sections by Corridor

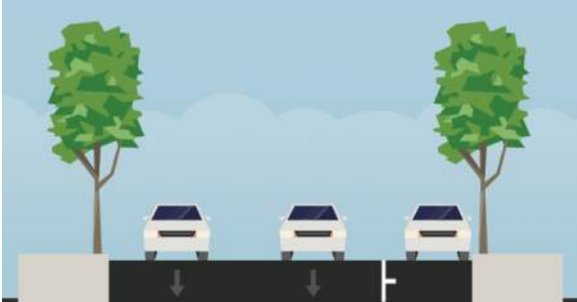



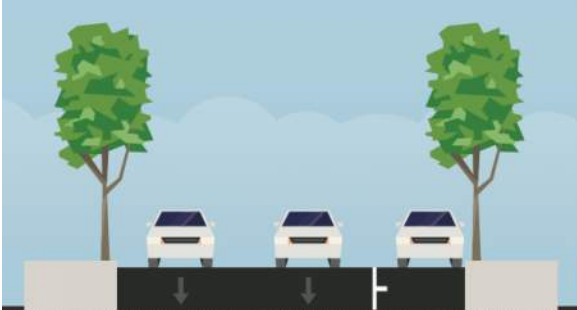







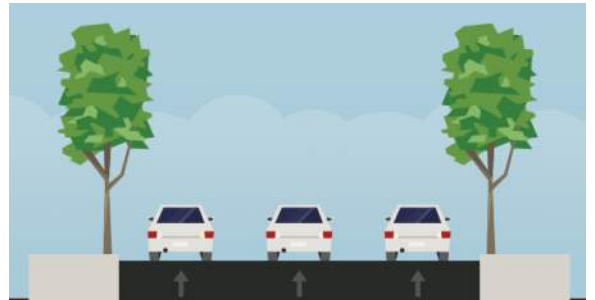

Existing	Proposed
<p>21st St – Between Pennsylvania Ave NW and C St NW</p> 	<p>21st St – South of New Hampshire Ave NW</p> 
<p>21st St – South of C St NW</p> 	<p>21st St – South of C St NW</p> 
<p>20th St – North of Q St NW</p> 	<p>20th St – North of Massachusetts Ave NW</p> 
<p>20th St – Between Q St NW and Massachusetts Ave NW</p> 	<p>20th St – North of Massachusetts Ave NW</p> 

Table 8: Existing and Proposed Cross Sections by Corridor

Existing	Proposed
<p>20th St – Between Massachusetts Ave NW and New Hampshire Ave NW</p> 	<p>20th St – Between Massachusetts Ave NW and New Hampshire Ave NW</p> 
<p>20th St – Between New Hampshire Ave NW and K St NW</p> 	<p>20th St – Between New Hampshire Ave NW and K St NW</p> 
<p>20th St – Between I St NW and F St NW</p> 	<p>20th St – Between I St NW and F St NW</p> 

Study Corridors

Project goals emphasized safer streets for all modes and minimal impacts to buses, autos and parking. In order to select a recommended alternative from the three corridors, each alternative was analyzed based on safety, bus operations, vehicle operations, and parking/curbside impacts. This section includes details of how these concepts fit within the street cross-section and complementary safety improvements considered to improve designs. Relative safety was evaluated based on:

- Continuous protection
- Improved pedestrian crossings

- Number of left-turn and right-turn conflicts
- Number of driveway conflicts

Meanwhile, traffic impacts were assessed based on a comparison of intersection vehicular delay between 2040 No Build and 2040 Build conditions. Those intersections projected to degrade to a LOS E or worse under 2040 Build conditions were considered to have a project impact. Parking impacts were evaluated based on the removal of parking spaces and by parking type. Significant reductions to residential parking both daytime and overnight were considered too great an impact to the community. The three design alternatives sought to minimize impacts to transit by implementing floating bus stop islands wherever there was enough right-of-way.

The selected metrics highlighted the strengths and weaknesses of conceptual design elements at the intersection level and corridor wide.

22nd Street NW

Overview

The 22nd Street alternative implements a continuous two-way protected bike lane on the east side of the street. This equates to 10 blocks of a fully protected facility between Massachusetts Avenue NW and F Street NW. The facility does not directly connect to the bike lanes on Q Street NW or R Street NW, but the Q Street NW bike lane is only one block away and subsequent design phases could address this issue. This facility connects to the National Mall via one-way protected bike lanes on G and F Streets that connect with 21st Street, where the two-way protected bike lane would continue to the National Mall. Full concepts for the 22nd Street corridor are available in **Appendix C**.

Design

As noted in Table 6 above, the 22nd Street design repurposes a parking lane on the east side of the street for the two-way protected bike lane. The street transitions from three northbound travel lanes in the peak hour to two northbound travel lanes. Three key design challenges are described below.

22nd Street NW/ Q Street NW

At the northern end of the corridor, the Q Street intersection presents key design challenges given its proximity to the Massachusetts Avenue intersection. The PM northbound right-turn volume at Q Street exceeds the 100-vehicle threshold, noted in Table 5 above, and requires phase separation to ensure limited conflicts between turning vehicles and crossing bicyclists and pedestrians. As shown in **Figure 6** below, the roadway width does not allow for a separate right-turn lane so the inclusion of exclusive signal

phase for the pedestrians and bicycles requires the addition of a new signal phase. In order to accommodate this phase, the amount of time for the other phases of the intersection are reduced. The traffic impacts of this design are discussed in detail below.

22nd Street NW / New Hampshire Avenue NW

The New Hampshire Avenue intersection is a six-legged intersection between 22nd Street, New Hampshire Avenue and L Street. The 22nd Street facility connects to existing bicycle lanes on L Street and New Hampshire Avenue and the design includes safe and intuitive connections between all facilities. As shown in **Figure 7** below, a protected curb extension is recommended at the northeast corner of L Street which provides a refuge for bicyclists traveling north and south on 22nd Street, as well as those traveling east on L Street. A two-stage turn queue box placed at the southwest approach of New Hampshire Avenue connects northbound and southbound cyclists from 22nd Street to southwest travel on New Hampshire Avenue. A separate right-turn lane is recommended for northbound vehicles on 22nd Street turning either onto New Hampshire Avenue or L Street due to the high right-turn volumes for the two streets combined, which exceed the 100-vehicle threshold.

22nd Street NW / M Street NW

The M Street intersection is just south of the Marriot Hotel, which also has two existing high-volume driveways and a taxi parking area. The design shown in **Figure 8** below proposes to relocate the taxi parking in favor of the protected bike lanes. At the M Street intersection, the 22nd Street facility connects to the westbound bike lane on M Street by way of a two-stage turn queue box on the westbound approach of M Street. This location also features two raised pedestrian refuge islands on the north and south legs of 22nd Street which promote a slow speed turn for westbound vehicles on M St to travel north on 22nd Street and provide pedestrians with a refuge area.

Safety

Table 9 below summarizes the 22nd Street design as it relates to safety. The proposed design features two opportunities for pedestrian refuge islands at M Street and Pennsylvania Avenue, and reduces the potential for conflicts between right-turning vehicles and pedestrians by restricting right-turns on red at five intersections. Given that 22nd Street is a one-way northbound street and the proposed facility is on the east side, the potential for conflicts between vehicles and bicyclists is higher. While all high volume right-turns have been phase separated, there are six locations which did not meet the 100-vehicle threshold but still represent conflicts:

- 22nd St / P St
- 22nd St / O St
- 22nd St / K St
- 22nd St / Pennsylvania Ave
- 22nd St / I St
- 22nd St/H St

Table 9: Safety Features of 22nd St Proposed Design

Feature	Summary
Bike Lane Protection	100% of corridor is protected
Pedestrian Safety Improvements	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 2• Separate phase for pedestrian crossings: 1• No right turns on red: 5
Left Turn Conflicts with Bicyclists	None
Right Turn Conflicts with Bicyclists	<ul style="list-style-type: none">• 2 high volume right turn conflict intersections (> 100 VPH) have been phase separated• 6 low volume right turn conflict intersections (< 100 VPH)
Driveway Crossings with Bike lane	<ul style="list-style-type: none">• 19 high volume (includes alleys)• 17 low volume

Traffic Analysis

Implementing the proposed protected bike lanes requires reducing the roadway capacity and results in congestion and additional travel time along 22nd Street NW. The following intersections operate at LOS E or below with the proposed 22nd Street design:

- 22nd Street / Florida Avenue / Massachusetts Avenue (PM only)
- 22nd Street / Q Street (PM only)
- 22nd Street / L Street / New Hampshire Avenue (AM and PM)

While the separate phase at Q Street offers safety benefits, it results in a project impact to traffic operations, degrading the level of service to unacceptable levels during the PM peak hour. **Table 10** below summarizes the results of the traffic analysis under 2040 No Build and 2040 Build conditions.

Figure 6: 22nd St & Q St Proposed Design



Figure 7: 22nd St & L St & New Hampshire Ave Proposed Design

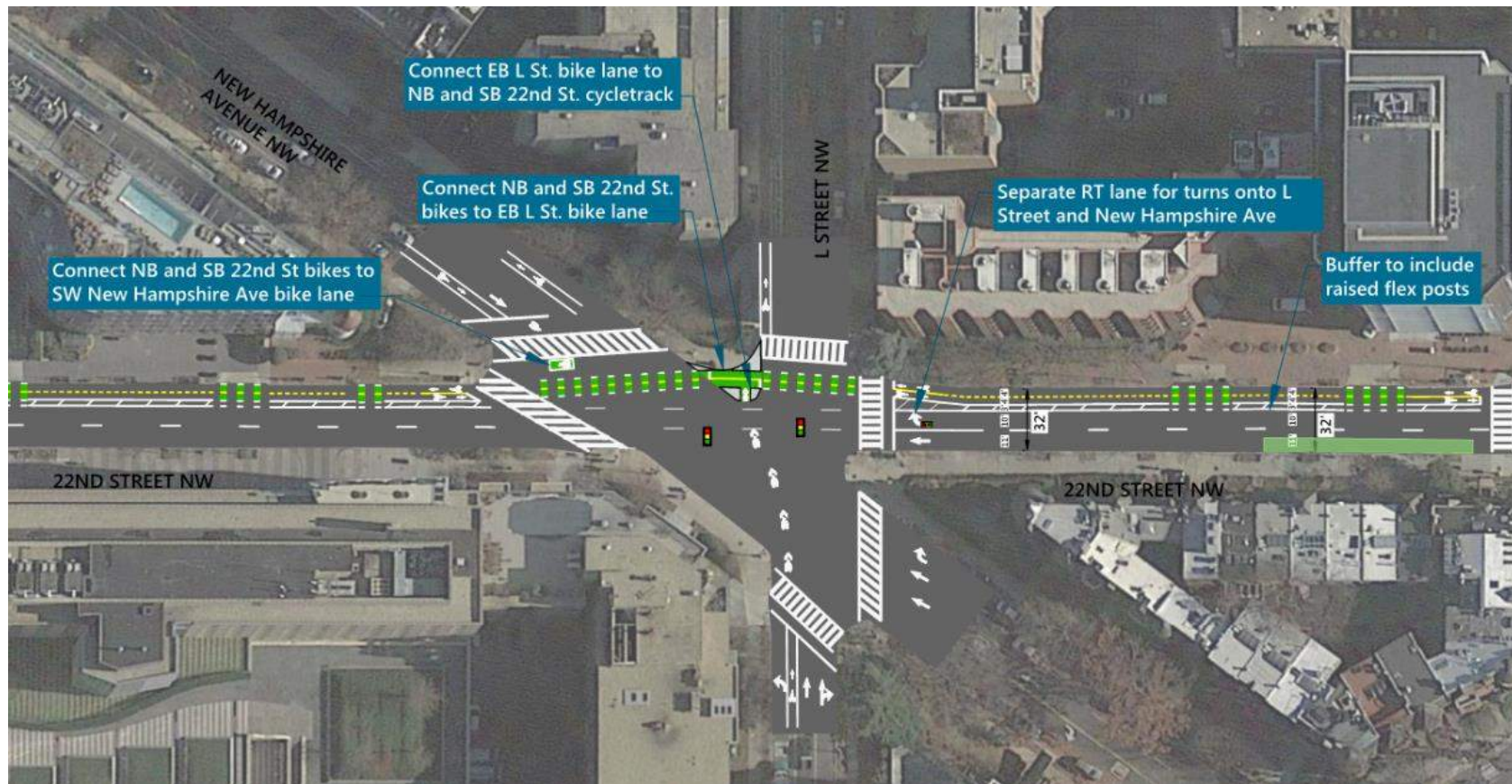


Figure 8: 22nd St & M St Proposed Design

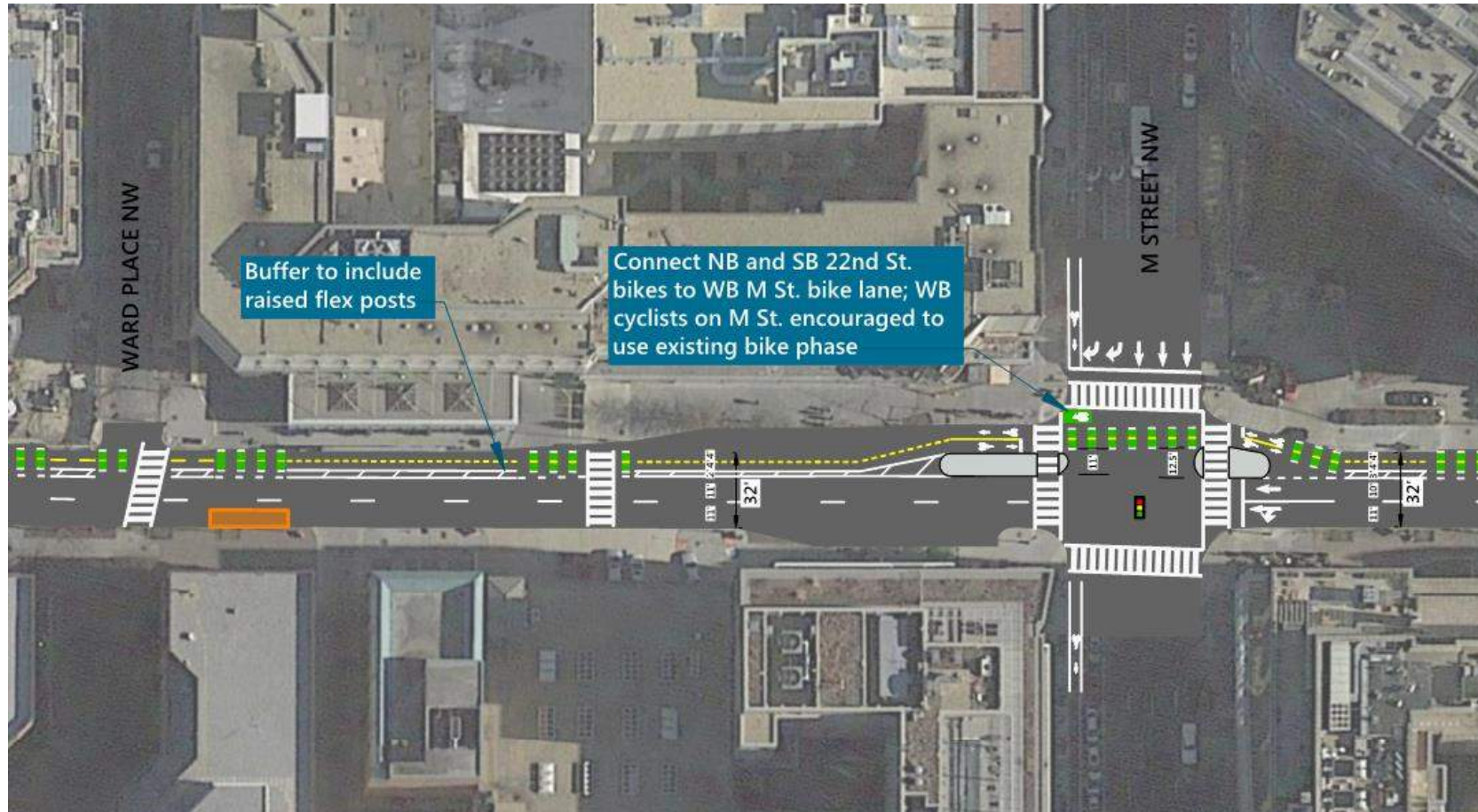


Table 10: 22nd St NW Traffic Analysis Results for 2040 Conditions

Intersection Location	AM Peak Hour				PM Peak Hour			
	2040 No Build		2040 Build		2040 No Build		2040 Build	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
22 nd St / Florida Ave / Massachusetts Ave	52.4	D	46.2	D	57.7	E	114.6	F
22 nd St / Q St	14	B	54.5	D	44.2	D	127.2	F
22 nd St / P St	23.4	C	22.6	C	26.1	C	32.1	C
22 nd St / N St	16.7	B	16.1	B	27	C	30.5	C
22 nd St / M St NW	17.4	B	14.2	B	11.8	B	11.6	B
22 nd St / L St / New Hampshire Ave	63.4	E	116.2	F	91.3	F	89.2	F
22 nd St / K St WB	12.1	B	7.4	A	26.2	C	11.6	B
22 nd St / K St EB	8.2	A	9.7	A	10.4	B	14.8	B
22 nd St / Pennsylvania Ave	17.6	B	14.6	B	23.4	C	17.2	B
22 nd St / I St	27.7	C	28.5	C	32.2	C	27.3	C
22 nd St / G St	16.6	B	12.2	B	17.3	B	10.6	B
22 nd St / F St	14.1	B	13.3	B	6.5	A	6.2	A

Parking Analysis

The proposed 22nd Street facility significantly impacts parking by removing a total of 126 spaces. Most of these spaces are AM or PM restricted, which equates to overnight parking opportunities for nearby residents. **Table 11** below presents the changes in parking supply with the proposed design.

Table 11: Proposed 22nd St NW Parking Impacts

	Existing	Proposed
Total Parking	214 spaces	About 88 (-126 spaces)
Residential Permit Spaces (RPP)	12 spaces	0 (-12 spaces)
Embassy Spaces	0 spaces	0 (-0 spaces)
Taxi or Loading	7 spaces	0 (-7 spaces)
All-Day Metered	32 spaces	0 (-32 spaces)
AM or PM Peak Restricted	136 spaces	About 57 (-79 spaces)
No Parking 7am-6:30pm	39 spaces	About 31 (-8 spaces)

Changes to Bus Stops

There are no bus stops along 22nd St, and therefore this design alternative does not result in any changes to bus stops.

Feedback from the Public and Stakeholders

Those in favor of the 22nd St alternative cited the lower overall parking impacts and the heavier activity of retail, hotels, and restaurants along the corridor providing attractive destinations as their reasoning. However, most of the feedback on 22nd St was not in favor of selecting this corridor. Those against 22nd St cited heavy impacts to residential parking as a major factor. Participants also noted it was not an attractive cycling environment due to the heavy traffic at Washington Circle and Sheridan Circle, and the heavy volume of emergency vehicles using 22nd St to access GW Hospital. For bicyclists, 22nd St offers limited benefits to connectivity across the bicycle network given that it does not connect to Constitution Ave, nor does it connect to existing bike lanes on Q St and R St.

21st Street NW

Overview

The 21st Street alternative features a continuous two-way protected bike lane on the east side of the street. This alternative extends from Florida Avenue NW to Constitution Avenue NW and equates to 14 blocks of fully protected bike lanes. This alternative enhances the bicycle network by connecting to the

bike lanes on Q Street NW, R Street NW, New Hampshire Ave NW, L St NW, M St NW, and provides a direct connection to the National Mall. A second option for 21st Street explored a contra-flow bicycle lane between Florida Avenue NW and New Hampshire Avenue NW. The team explored this option to reduce residential parking impacts, and this reduces the alternative to nine blocks of fully protected bike lanes. Full concepts for the 21st Street corridor are available in **Appendix D**.

Design

As noted in Table 6 above, the 21st Street design repurposes a parking lane on the east side of the street for the two-way protected bike lane. North of New Hampshire Avenue, the street transitions from two southbound travel lanes in the peak hour to one southbound travel lane. South of New Hampshire Avenue, the street transitions from three southbound travel lanes in the peak hour to two southbound travel lanes. Two key design challenges are described below.

21st Street MW & P Street NW

The proposed design at 21st Street & P Street removes residential parking spaces on the north leg in order to accommodate a separate left-turn lane. Through vehicles transition across the intersection to align with 21st Street southbound. As shown in **Figure 9** below, this location also features bike boxes on the southbound approach of 21st Street and a two-stage turn queue box on the westbound approach of P Street to facilitate bicycle connections between 21st Street and P Street. For improved safety, right-turns on red are prohibited for southbound vehicles on 21st Street.

21st Street NW & C Street NW

The 21st & C Street intersection is just south of the Federal Reserve Board (FRB) office building and the US Department of State office building. As shown in **Figure 10** below, this area presents unique design challenges in the heavy peaking characteristics of the driveways, and the FRB loading and truck inspection area on the east side of 21st Street. Conversations with FRB concluded that relocating the loading and truck inspection area was not an option. As a result, the design shows the bicycle facility in such a way to align with the curb for as long as possible before entering the mixing zone to cross the building driveway and the inspection area entrance. Subsequent design phases should revisit this section as the FRB and US Department of State development plans become clear. In order to maintain phase separation for southbound left-turning vehicles on 21st Street, the design proposes a change to the 21st Street & C Street signal so that northbound vehicles, southbound vehicles, and northbound and southbound bicyclists and pedestrians get separate green time to avoid heavy turn conflicts.

Figure 9: 21st St & P St Proposed Design

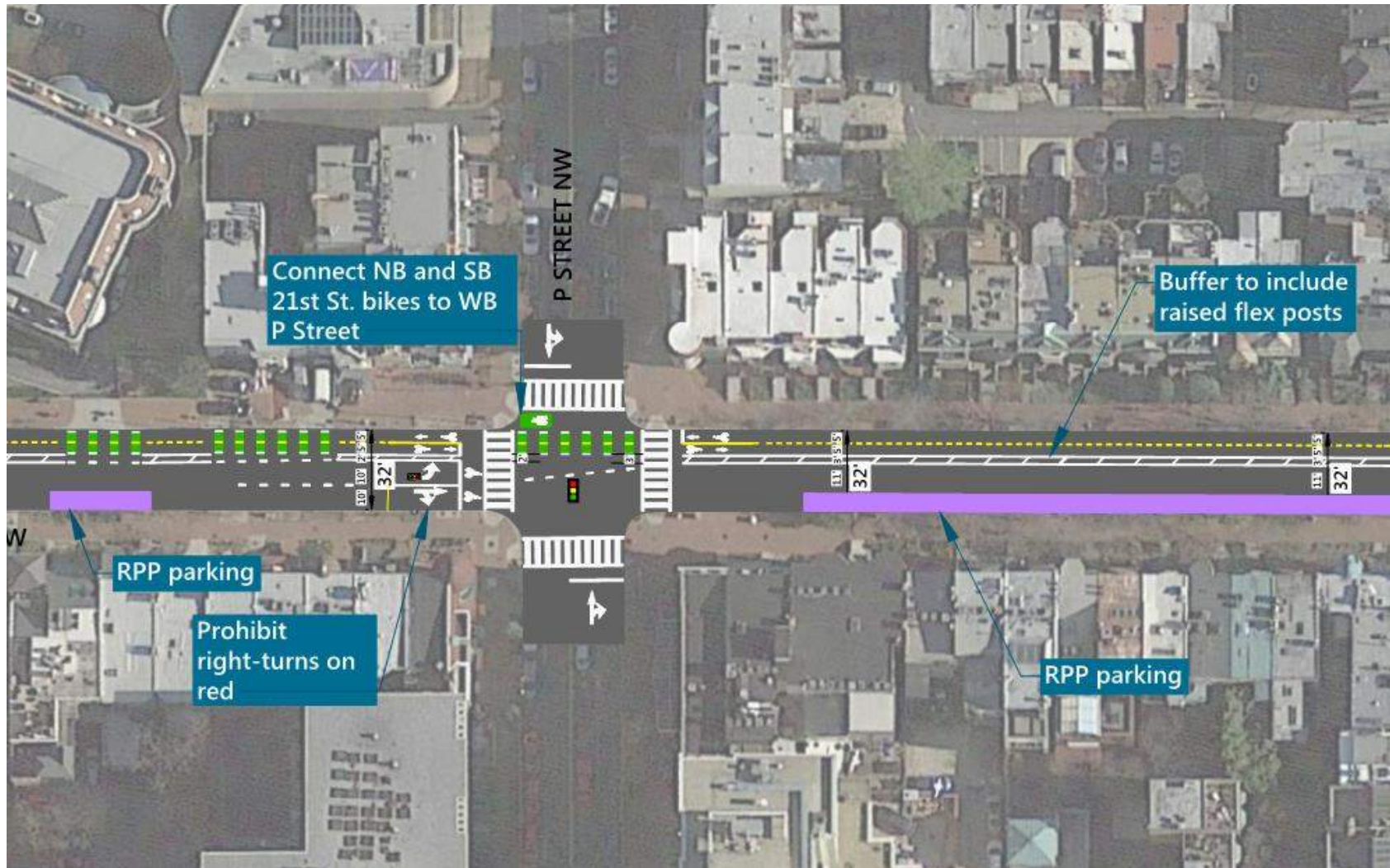
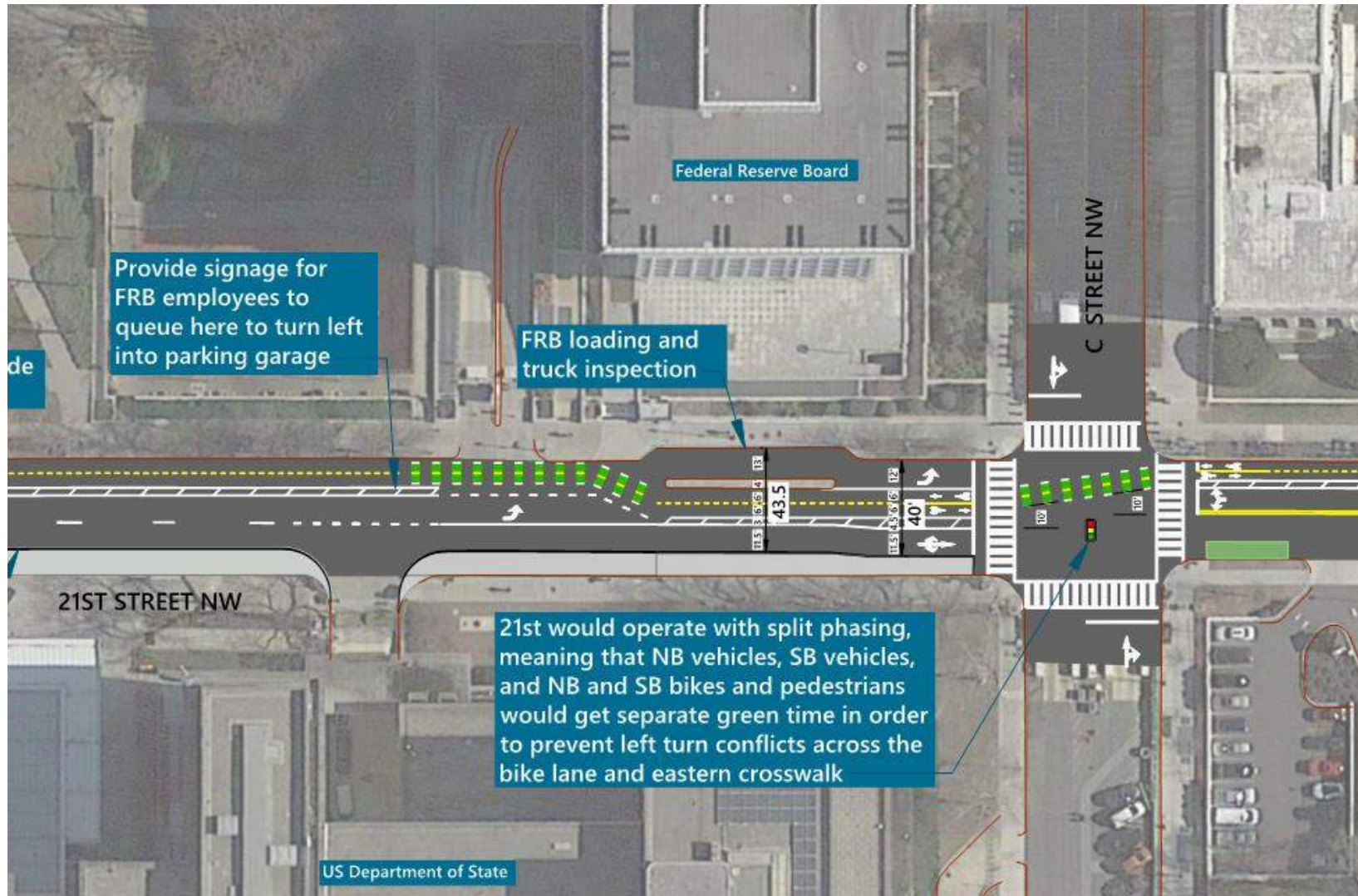


Figure 10: 21st St & C St Proposed Design



Safety

Table 12 below summarizes the 21st Street design as it relates to safety. The proposed design reduces conflicts between right-turning vehicles and pedestrians by restricting right-turns on red at nine intersections. Compared to the other two alternatives, there are fewer turn conflicts along 21st Street, which avoids significant impacts to traffic operations because there are fewer intersections that require phase separation. This corridor has the highest number of total driveway conflicts as well as the highest number of high-volume driveway conflicts. The proposed design manages these driveway conflicts using green conflict zone pavement markings, signage, and by providing clear lines of sight.

Table 12: Safety Features of 21st St Proposed Design

Feature	Summary
Bike Lane Protection	100% of corridor is protected
Pedestrian Safety Improvements	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 0• Separate phase for pedestrian crossings: 3• No right turns on red: 9
Left Turn Conflicts with Bicyclists	All left turns are phase separated at signalized intersections
Right Turn Conflicts with Bicyclists	<ul style="list-style-type: none">• 1 high volume right turn conflict intersection (> 100 VPH) has been phase separated
Driveway Crossings with Bike lane	<ul style="list-style-type: none">• 21 high volume (includes alleys)• 33 low volume

Traffic Analysis

Implementing the proposed protected bike lanes requires reducing the roadway capacity and results in congestion and additional travel time along 21st Street NW. **Table 13** summarizes the results of the traffic analysis. The following intersections operate at LOS E or below with the proposed 20th Street design:

- 21st Street / New Hampshire Avenue (AM and PM)
- 21st Street / C Street (PM only)
- 21st Street / Constitution Avenue (PM only)

Table 13: 21st St NW Traffic Analysis Results for 2040 Conditions

Intersection Location	AM Peak Hour				PM Peak Hour			
	2040 No Build		2040 Build		2040 No Build		2040 Build	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
21 st St / Florida Ave / S St	11.8	B	5.5	A	5.3	A	5.3	A
21 st St / Massachusetts Ave	13.5	B	16.1	B	18.2	B	12.8	B
21 st St / P St	15.3	B	18.1	B	14	B	20.3	C
21 st St / New Hampshire Ave	22.9	C	93.9	F	43.6	D	311.5	F
21 st St / M St NW	16.8	B	23.3	C	24.7	C	33.6	C
21 st St / L St	17.1	B	24.8	C	16.2	B	22.6	C
21 st St / K St	15.8	B	31.3	C	13.7	B	38.7	D
21 st St / Pennsylvania Ave	27.7	C	39.6	D	16	B	25.3	C
21 st St / I St	11	B	36.6	D	6.9	A	11.3	B
21 st St / H St	8.4	A	11.7	B	9.9	A	43.3	D
21 st St / G St	7.9	A	9.5	A	7.8	A	8.6	A
21 st St / F St	8.8	A	4.9	A	6.2	A	23.1	C
21 st St / E St	17.1	B	9.2	A	15.2	B	16.8	B
21 st St / Virginia Ave	10.1	B	19.2	B	10.8	B	22.6	C
21 st St / C St	7.5	A	35.1	D	4.5	A	341.7	F
21 st St / Constitution Ave	10.6	B	54.2	D	120.1	F	166.9	F

Parking Analysis

The proposed 21st Street facility significantly impacts parking by removing a total of 215 spaces from the street. This represents the greatest impact to parking between the three alternatives. North of New Hampshire Avenue, the neighborhood is residential in nature and therefore most of these lost parking spaces represent an impact to either daytime or overnight residential parking. **Table 14** below presents the changes in parking supply with the proposed design.

Table 14: Proposed 21st St NW Parking Impacts

	Existing	Proposed
Total Parking	355 spaces	About 140 (-215 spaces)
Residential Permit Spaces (RPP)	135 spaces	About 60 (-75 spaces)
Embassy Spaces	9 spaces	0 (-9 spaces)
Taxi or Loading	11 spaces	About 8 (-3 spaces)
All-Day Metered	40 spaces	About 5 (-35 spaces)
AM or PM Peak Restricted	52 spaces	About 37 (-15 spaces)
No Parking 7am-6:30pm	108 spaces	About 30 (-78 spaces)

Changes to Bus Stops

There are no bus stops along the east side of 21st St, and therefore this design alternative does not result in any impacts.

Feedback from the Public and Stakeholders

21st St generated the most public comments, both for those in support of and against that alternative. Those in favor of the 21st St alternative cited it provides the most connectivity with existing bike infrastructure and is a straight commute to the National Mall. Many participants noted that cyclists already use 21st St to connect to Q St and R St. Those against the 21st St design alternative expressed concerns over heavy impacts to residential parking and key loading areas along the corridor that would conflict with the facility. As a compromise, some public meeting participants suggested installing a protected bike lane on the section south of New Hampshire Ave and either regular bike lanes or a

contraflow bike lane north of New Hampshire Ave in order to preserve existing residential parking. Other comments about the 21st St alternative expressed concern over the dangerous intersection at New Hampshire Ave and the high demands for parking and loading north of R St and south of F St.

Contra-flow Option

As part of this study, the project team explored an option on 21st Street NW to design a northbound unprotected contra-flow bike lane on the east side of 21st Street NW between Florida Avenue NW and New Hampshire Avenue NW, and bicyclists share the lane with vehicles in the southbound direction. South of New Hampshire Avenue NW, this option includes a continuous protected bike lane on the east side of the street extending to Constitution Avenue NW. **Table 15** below summarizes the safety elements of the contra-flow option. **Figure 11** shows an existing contra-flow lane on T St NW as an example cross-section.



Figure 11: Existing Contra-flow Bike Lane T St NW

Table 15: Safety Features of 21st St Contra-Flow Option Proposed Design

Feature	Summary
Bike Lane Protection	65% of corridor is protected
Pedestrian Safety Improvements	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 0• Separate phase for pedestrian crossings: 2• No right turns on red: 6
Left Turn Conflicts with Bicyclists	<ul style="list-style-type: none">• 2 left turn conflicts north of New Hampshire Ave• All left turns are phase separated south of New Hampshire Ave
Right Turn Conflicts with Bicyclists	<ul style="list-style-type: none">• 1 high volume right turn conflict intersection (> 100 VPH) has been phase separated
Driveway Crossings with Bike lane	<ul style="list-style-type: none">• 21 high volume (includes alleys)• 33 low volume

The 21st Street contra-flow option was not included as a separate traffic analysis scenario. The results south of New Hampshire Avenue are consistent with those presented in Table 11 above. **Table 16** below summarizes the parking impacts associated with the contra-flow option.

Table 16: Proposed 21st St NW Contra-Flow Option Parking Impacts

	Existing	Proposed
Total Parking	355 spaces	About 222 (-133 spaces)
Residential Permit Spaces (RPP)	135 spaces	About 128 (-7 spaces)
Embassy Spaces	9 spaces	About 8 (-1 spaces)
Taxi or Loading	11 spaces	About 9 (-2 spaces)
All-Day Metered	40 spaces	About 7 (-33 spaces)
AM or PM Peak Restricted	52 spaces	About 40 (-12 spaces)
No Parking 7am-6:30pm	108 spaces	About 30 (-78 spaces)

20th Street NW

Overview

The 20th Street alternative features a continuous two-way protected bike lane on the west side of the street. This alternative extends between Connecticut Avenue NW and E Street NW and equates to 13 blocks of a fully protected two-way bike lane. This alternative connects to the existing one-way couplet bike lanes on Q and R Streets. This facility does not provide a direct connection to the National Mall and connects to 21st Street via one-way protected bike lanes on G Street and F Street. Bicyclists use a two-way protected bike lane on 21st Street to travel between G Street and the National Mall. Full concepts for the 20th Street corridor are available in **Appendix E**.

Design

As noted in Table 6 above, the 20th Street design repurposes a parking lane on the west side of the street for the two-way protected bike lane. 20th Street features varying roadway widths, directions of travel, and cross-sections, but the proposed design maintains two travel lanes for the entire extent of the corridor. As a result, this concept removes parking from both sides of the street except between New Hampshire Avenue and I Street, which features parking protected bike lanes. Three key design locations are described below.

20th Street NW & Q Street NW

The section of 20th Street, north of Massachusetts Avenue requires additional study as it features a diverse range of activity and users. Some of these include the year-round Dupont Farmers Market, which blocks off 20th Street to vehicles on Sundays for five hours, as well as transit users at the Metro station and the existing bus stop at the northwest corner of the 20th Street & Q Street intersection. As indicated in **Figure 12** below, additional discussion is needed with key stakeholders around the design and proposed physical barrier within the Farmer's Market area. This includes coordination with the Connecticut Avenue Deck Over and Streetscape Project. 20th Street connects to eastbound bike lanes on Q Street via proposed bike boxes and a two-stage turn queue box, which is an important feature of this corridor.

20th Street & New Hampshire Avenue

The New Hampshire Avenue intersection is a five-legged intersection between 20th Street, New Hampshire Avenue, and Sunderland Place. The 20th Street facility connects to existing bicycle lanes on New Hampshire Avenue and the design includes safe and intuitive connections between all facilities. As shown in **Figure 13** below, bike boxes on all New Hampshire Avenue and 20th Street approaches, as well as a two-stage turn queue box at the northeast approach on New Hampshire Avenue, connect northbound and southbound cyclists from 20th Street to New Hampshire Avenue and vice versa. This location is recommended to change the signal phasing so that northbound and southbound vehicles on 20th Street receive separate signal phases. Northbound and southbound bicyclists and pedestrians cross New Hampshire Avenue coinciding with northbound vehicles in order to avoid the high volume of southbound right-turn conflicts. Lastly, this design relocates an existing bus stop at the northeast corner of 20th Street to New Hampshire Avenue, which is along its travel route, because 20th St is not wide enough to accommodate the required floating bus island outside of the protected bikeway.

20th Street NW & L Street NW

The 20th & L Street intersection connects the 20th Street facility with existing eastbound bike lanes on L Street, and the design includes a safe and intuitive connection for bicyclists. As shown in **Figure 14** below, the design proposes a protected northwest corner to clearly define pedestrian and bicyclist operating spaces and minimizes potential conflicts between users. The corner refuge island protects bicyclists from turning vehicles by physically separating the L Street bike lane up to the point where the bicyclist crosses 20th Street. This extends the physical barrier of the protected bike lane into the intersection and provides a forward stop bar for cyclists to provide a "head start" and improve visibility of bicyclists. The protected corner also helps facilitate the right turn for northbound bicyclists on 20th Street to travel east on L Street.

Safety

Table 17 below summarizes the 20th Street design as it relates to safety. 20th Street has sections that are one-way northbound, one-way southbound, and two-way. With the two-way protected bike lane on the west side, the proposed design limits conflicts between turning vehicles and bicyclists and pedestrians. Between the three alternatives, 20th Street features the lowest number of turn conflicts and lowest number of driveway conflicts. Specific recommendations, such as the protected corner described above at L Street and restricting left-turns at three intersections contribute to the enhanced safety of crossing bicyclists and pedestrians without significantly degrading traffic operations.

Table 17: Safety Features of 20th St Proposed Design

Feature	Summary
Bike Lane Protection	100% of corridor is protected
Pedestrian Safety Improvements	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 1• Separate phase for pedestrian crossings: 1• No right turns on red: 2
Left Turn Conflicts with Bicyclists	All left turns are phase separated at signalized intersections
Right Turn Conflicts with Bicyclists	<ul style="list-style-type: none">• 1 high volume right turn conflict intersection (>100 VPH) has been phase separated• 2 low volume right turn conflict intersections (<100 VPH)
Driveway Crossings with Bike lane	<ul style="list-style-type: none">• 16 high volume (includes alleys)• 15 low volume

Traffic Analysis

Implementing the proposed protected bike lanes requires reducing the roadway capacity and results in undesirable congestion and additional travel time along 20th Street NW. The following intersections operate at LOS E or below with the proposed 20th Street design:

- 20th Street / G Street (AM only)

The design proposes a separate phase for bicyclists and pedestrians at the 20th Street & G Street intersection in order to separate left-turning vehicles while maintaining a consistent traffic pattern for northbound vehicles on 20th Street. While the separate phase at G Street offers safety benefits, it results in a project impact to traffic operations, degrading the level of service to unacceptable levels during the AM peak hour. **Table 18** below summarizes the results of the traffic analysis under 2040 No Build and 2040 Build conditions.

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Figure 13: 20th St & New Hampshire Ave Proposed Design

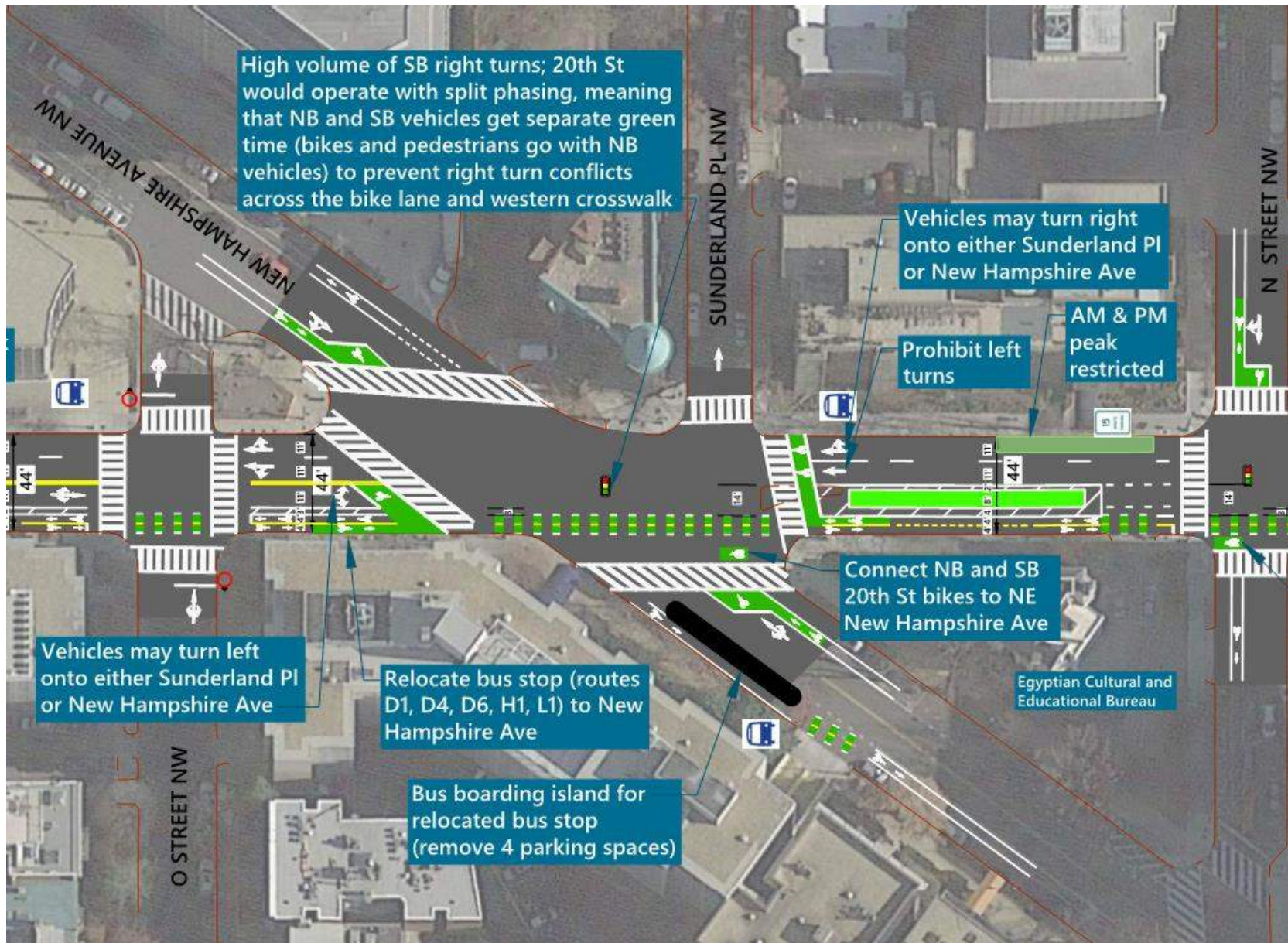
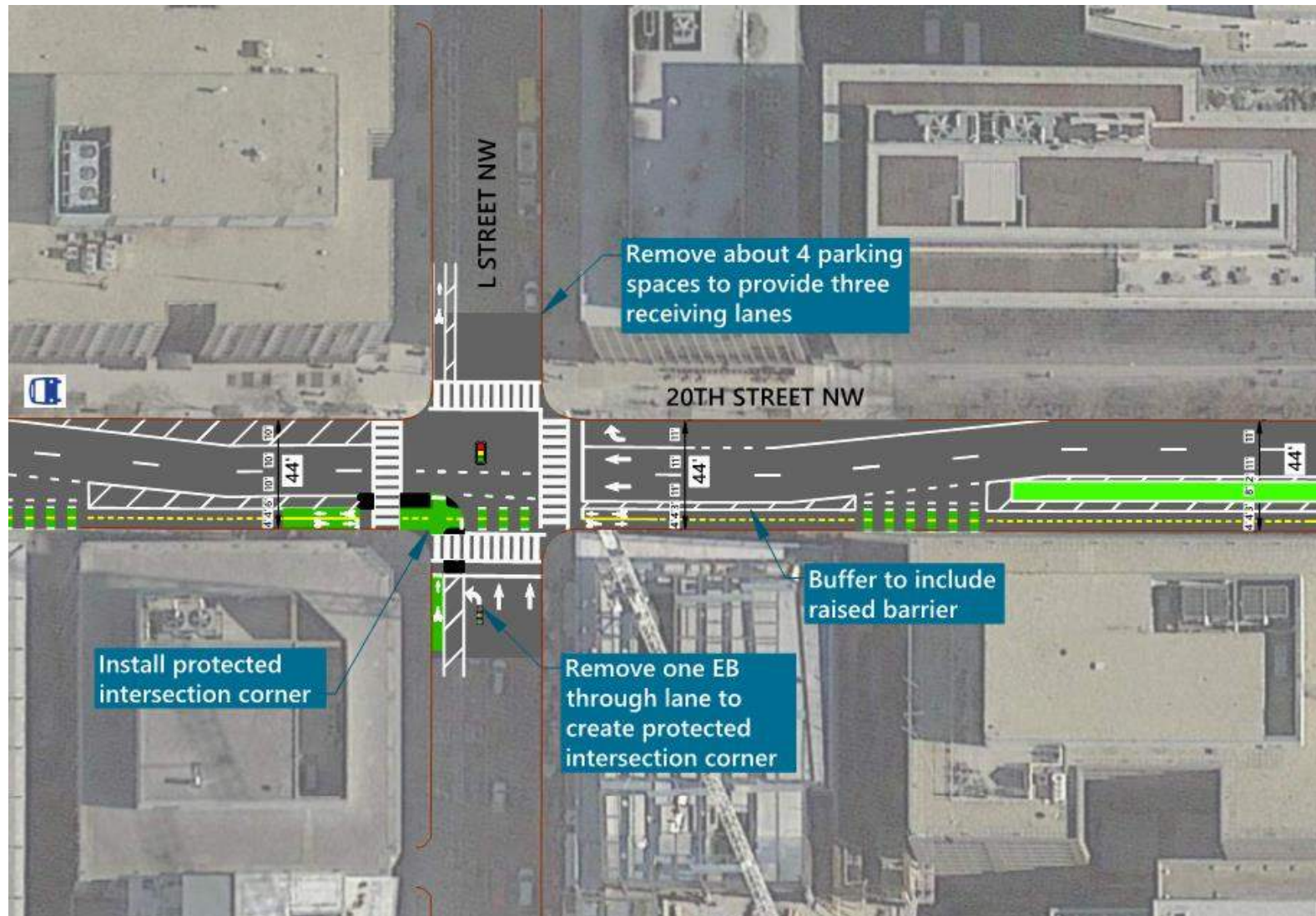


Figure 14: 20th St & L St Proposed Design



By comparison, this alternative proposes the most substantial changes in lanes and traffic conditions. These include:

- Restricting left-turns (New Hampshire Ave, Pennsylvania Ave, and H St)
- Removing two peak travel lanes between New Hampshire Ave and I St
- Replacing peak restricted parking with all-day metered parking as parking protected bike lanes

As a result of these recommendations, the 20th St design alternative achieves an optimum modal balance with the highest safety benefits as discussed above.

Table 18: 20th St NW Traffic Analysis Results for 2040 Conditions

Intersection Location	AM Peak Hour				PM Peak Hour			
	2040 No Build		2040 Build		2040 No Build		2040 Build	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
20 th St / Q St	16.6	C	31.9	B	23.7	C	17.7	B
20 th St / Massachusetts Ave	14.4	B	22.3	C	18.1	B	26	C
20 th St / P St	11	B	16.2	B	14.2	B	19.8	B
20 th St / New Hampshire Ave / Sunderland Pl	16.1	B	26.2	C	14.2	B	26.2	C
20 th St / N St	6.5	A	15.7	B	9.3	A	20.5	C
20 th St / M St NW	13.8	B	17.2	B	18.5	B	18.4	B
20 th St / L St	12.1	B	11.7	B	17.1	B	18.5	B
20 th St / K St	12.1	B	17.2	B	11.5	B	23.3	C
20 th St / I St	9.2	A	26.2	C	13.5	B	20	B
20 th St / Pennsylvania Ave	13.4	B	26.4	C	22.1	C	16.9	B
20 th St / H St	10.4	B	17.9	B	10.9	B	12.3	B
20 th St / G St	6.6	A	61.1	E	10.7	B	21.9	C
20 th St / F St	6.1	A	9.6	A	8.1	A	6	A
20 th St / E St	17.4	B	21.9	C	25.9	C	48.1	D

Parking Analysis

The proposed 20th Street facility impacts parking by removing a total of 143 spaces from the street. 20th Street does not have any residential permit parking under existing conditions, and therefore does not result in any loss to daytime residential parking. The greatest impact is to AM or PM peak restricted parking, but this is also due to the project team's decision to remove peak restricted parking in favor of all-day metered parking along portions of the corridor. **Table 19** below presents the changes in parking supply with the proposed design.

Table 19: Proposed 20th St NW Parking Impacts

	Existing	Proposed
Total Parking	216 spaces	About 73 (-143 spaces)
Residential Permit Spaces (RPP)	0 spaces	0 (-0 spaces)
Embassy Spaces	0 spaces	0 (-0 spaces)
Taxi or Loading	18 spaces	0 (-18 spaces)
All-Day Metered	41 spaces	About 38 (-3 spaces)
AM or PM Peak Restricted	133 spaces	About 25 (-108 spaces)
No Parking 7am-6:30pm	24 spaces	About 10 (-14 spaces)

Changes to Bus Stops

20th St is particularly challenging from a design perspective, as there are bus stops on both sides of the street and the street is one-way southbound, one-way northbound, and two-way at different points along the corridor. The bus stops on the west side of the street are limited to the northern section of the corridor and solutions were identified to mitigate the conflict between buses and cyclists, such as stop relocation, consolidation, and floating bus stops. The 20th St alternative results in the greatest changes to bus stops due to three existing bus stops on the west side of the street which conflict with the proposed two-way protected bike lane.

20th St / Q St

The existing bus stop on the northwest corner of the intersection serves the H1 and L1 bus routes. This section of 20th St is where the Dupont Farmers Market currently takes places on the weekends. In subsequent design phases, as DDOT coordinates this section with representatives from the farmer's market, the appropriate design for the bus stop will be coordinated with WMATA.

20th St / Massachusetts Ave

The existing bus stop on the northwest corner of the intersection serves the H1 and L1 bus routes. The right-of-way width in this location does not allow for a floating bus island to accommodate bus boarding. This stop is recommended for removal given the existing stop one block north at Q Street.

20th St / P St

The existing bus stop on the southeast corner of the intersection serves the H1 and L1 bus routes. The P St intersection proposed design includes a separate northbound left-turn lane in order to remove conflicts between left-turning vehicles and the two-way protected bike lane. In order to accommodate a necessary northbound shared through-right-turn lane, the bus stop is recommended for removal. The next closest bus stop is one block south at the northeast corner of 20th St & O St and serves the same routes.

20th St / New Hampshire Ave

The existing bus stop on the northwest corner of the intersection serves the H1, L1, D1, D4, and D6 bus routes. The right-of-way width in this location does not allow for a floating bus island to accommodate bus boarding. This stop is recommended for relocation from the west side of 20th St to the north side of New Hampshire Ave. This relocation follows the existing bus routes and is a location with enough right-of-way to accommodate a floating bus island for safer interactions between the existing protected bike lane on New Hampshire Ave and the new bus stop location.

Feedback from the Public and Stakeholders

The 20th St design alternative generated the fewest number of comments against its selection. Those in favor of the 20th St alternative cited the safety benefits which include fewer driveway conflicts and fewer parking spaces that risk bicyclists being hit by car doors as they are passing by. Many noted their preference of 20th St due to its lower parking impacts, particularly for residential parking. Those against the 20th St alternative were concerned with the potential coordination issues with the Dupont Circle Farmer's Market, which many noted is an asset to the community and not to be disrupted.

Over the course of the project, DDOT received resolutions from both ANC 2A and 2B recommending 20th Street for the alignment.

Recommended Alternative

Project goals center around safer streets for all modes and minimal impacts to bus stop operations, traffic operations and parking. A recommended hybrid alternative shown in **Figure 15** was selected based on safety, bus operations and auto vehicle operations, and parking/curbside impacts. **Figure 16** below summarizes the design alternatives and how they compare relative to safety improvements, impacts to traffic operations, and impacts to parking. The project team used this comparison, as well as community feedback, to select a recommended alternative.

The recommended alternative is the 20th St corridor, which extends from Connecticut Avenue NW in the north to F Street NW. In order to complete the connection to the National Mall at Constitution Avenue, the protected bike lanes connect to 21st St in the southern section via one-way protected bike lanes on G Street and F Street. This recommendation provides fully protected two-way bike lanes along the west side of 20th St and the east side of 21st St that connects to existing bicycle facilities at R Street, Q Street, New Hampshire Avenue, M Street, and L Street.

Full concepts for the 20th Street corridor are available in **Appendix F**. 20th Street was ultimately selected because it presents the best case in providing a safe facility with minimal turn conflicts, minimal driveway crossings, and added pedestrian amenities. **Table 20** below summarizes the safety features of the recommended alternative.



Figure 15 Recommended Alternative Alignment

Figure 16 Summary of Design Alternatives

Summary of Alternatives - Updated 02-19-19					
	No Build	22nd Street NW	21st Street NW		20th Street NW
Alternatives	There will be no change in traffic configurations and travel patterns. Also no protection for bicyclists.	Continuous two-way protected bike lane on the east side of 22nd Street from Massachusetts Ave to F Street	Continuous two-way protected bike lane on the east side of 21st Street from Florida Ave to Constitution Ave	Contraflow Lane Option: <ul style="list-style-type: none">• Contraflow (northbound) unprotected bike lane and shared lane markings for southbound bicyclists from Florida Ave to New Hampshire Ave• Continuous two-way protected bike lane on the east side of 21st Street from New Hampshire Ave to Virginia Ave	Continuous two-way protected bike lane on the west side of 20th Street from Connecticut Ave to E Street
Safety / Design					
Bike Network Connectivity	None	<ul style="list-style-type: none">• Does not connect to the Q or R Street bike lanes, but potential to connect 1 block gap on Q Street• Does not provide a direct connection to the National Mall	<ul style="list-style-type: none">• Connects to the Q and R Street bike lanes• Provides a direct connection to the National Mall	<ul style="list-style-type: none">• Connects to the Q and R Street bike lanes• Provides a direct connection to the National Mall	<ul style="list-style-type: none">• Connects to the Q Street bike lane• Does not provide a direct connection to the National Mall, but potential for future connection via Virginia Ave and C Street to continue on 20th Street
Continuous Protection of Bike Lane	0% of corridor protected	100% of corridor protected 10 blocks, approx. 5140 feet	100% of corridor protected 14 blocks, approx. 7920 feet	65% of corridor protected 9 blocks, approx. 5130 feet	100% of corridor protected 13 blocks, approx. 7120 feet
Pedestrian Safety Improvements	None	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 2• Separate phase for pedestrian crossings: 1• No right turns on red: 5	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 0• Separate phase for pedestrian crossings: 3• No right turns on red: 9	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 0• Separate phase for pedestrian crossings: 2• No right turns on red: 6	Number of intersections with: <ul style="list-style-type: none">• Shorter pedestrian crossings: 1• Separate phase for pedestrian crossings: 1• No right turns on red: 2
Left Turn Conflicts with Bicyclists	Not applicable	All left turns are phase separated at signalized intersections	All left turns are phase separated at signalized intersections	<ul style="list-style-type: none">• 2 left turn conflicts north of New Hampshire Ave• All left turns are phase separated south of New Hampshire Ave	All left turns are phase separated at signalized intersections
Right Turn Conflicts with Bicyclists	Not applicable	<ul style="list-style-type: none">• 2 high volume right turn conflict intersections (>100 VPH) have been phase separated• 6 low-volume right turn conflict intersections (<100 VPH)	<ul style="list-style-type: none">• 1 high volume right turn conflict intersection (>100 VPH) has been phase separated	<ul style="list-style-type: none">• 1 high volume right turn conflict intersection (>100 VPH) has been phase separated	<ul style="list-style-type: none">• 1 high volume right turn conflict intersection (>100 VPH) has been phase separated• 2 low-volume right turn conflict intersections (<100 VPH)
Driveway Crossings with Bike Lane	Not applicable	<ul style="list-style-type: none">• 19 high volume (includes alleys)• 17 low volume	<ul style="list-style-type: none">• 21 high volume (includes alleys)• 33 low volume	<ul style="list-style-type: none">• 21 high volume (includes alleys)• 33 low volume	<ul style="list-style-type: none">• 16 high volume (includes alleys)• 15 low volume
Vehicle Operations					
Signalized Intersections with LOS > E in 2040	1 of 43 in AM 3 of 43 in PM	1 of 12 in AM 3 of 12 in PM	1 of 17 in AM 3 of 17 in PM	1 of 17 in AM 3 of 17 in PM	1 of 14 in AM 0 of 14 in PM
Vehicle Left Turn Restrictions	No changes	0 intersections propose restrictions	1 intersection proposes restrictions	1 intersection proposes restrictions	3 intersections propose restrictions
Parking / Curbside					
Total Parking	20th - About 216 spaces 21st - About 355 spaces 22nd - About 214 spaces	About 88 (-126 spaces)	About 140 (-215 spaces)	About 222 (-133 spaces)	About 73 (-143 spaces)
Residential Permit Spaces (RPP)	20th - About 0 spaces 21st - About 135 spaces 22nd - About 12 spaces	0 (-12 spaces)	About 60 (-75 spaces)	About 128 (-7 spaces)	0 (-0 spaces)
Embassy Dignatrics	20th - About 0 spaces 21st - About 9 spaces 22nd - About 0 spaces	0 (-0 spaces)	About 0 (-9 spaces)	About 8 (-1 space)	0 (-0 spaces)
Taxi or Loading	20th - About 18 spaces 21st - About 11 spaces 22nd - About 7 spaces	0 (-7 spaces)	About 8 (-3 spaces)	About 9 (-2 spaces)	0 (-18 spaces)
All-Day Metered	20th - About 41 spaces 21st - About 40 spaces 22nd - About 32 spaces	0 (-32 spaces)	About 5 (-35 spaces)	About 7 (-33 spaces)	About 38 (-3 spaces)
AM or PM Peak Restricted	20th - About 133 spaces 21st - About 52 spaces 22nd - About 136 spaces	About 57 (-79 spaces)	About 37 (-15 spaces)	About 40 (-12 spaces)	About 25 (-108 spaces)
No Parking 7am-6:30pm	20th - About 24 spaces 21st - About 108 spaces 22nd - About 39 spaces	About 31 (-8 spaces)	About 30 (-78 spaces)	About 30 (-78 spaces)	About 10 (-14 spaces)

Table 20: Safety Features of Recommended Alternative Design

Feature	Summary
Bike Lane Protection	100% of corridor is protected
Pedestrian Safety Improvements	Number of intersections with: <ul style="list-style-type: none"> • Shorter pedestrian crossings: 1 • Separate phase for pedestrian crossings: 2 • No right turns on red: 3
Left Turn Conflicts with Bicyclists	All left turns are phase separated at signalized intersections
Right Turn Conflicts with Bicyclists	<ul style="list-style-type: none"> • 2 high volume right turn conflict intersection (> 100 VPH) has been phase separated • 2 low volume right turn conflict intersections (<100 VPH)
Driveway Crossings with Bike lane	<ul style="list-style-type: none"> • 20 high volume (includes alleys) • 15 low volume

The following intersections operate at LOS E or below with the proposed 20th Street design:

- 20th Street / G Street (AM only)
- 21st Street / C Street (PM only)
- 21st Street / Constitution Ave (AM and PM)

Project impacts at 20th Street & G Street and at 21st Street & C Street are due to proposed signal modifications to separate conflicts between turning vehicles and crossing bicyclists and pedestrians. Meanwhile, the 21st Street & Constitution Avenue intersection operates at unacceptable conditions during both scenarios in the PM peak hour. **Table 21** below summarizes the traffic operations associated with the recommended alternative under 2040 No Build and 2040 Build Conditions.

Table 21: Recommended Alternative Traffic Analysis Results for 2040 Conditions

Intersection Location	AM Peak Hour				PM Peak Hour			
	2040 No Build		2040 Build		2040 No Build		2040 Build	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
20 th St / Q St	16.6	B	31.9	C	23.7	C	17.7	B
20 th St / Massachusetts Ave	14.4	B	22.3	C	18.1	B	26	C
20 th St / P St	11	B	16.2	B	14.2	B	19.8	B
20 th St / New Hampshire Ave / Sunderland Pl	16.1	B	26.2	C	14.2	B	26.2	C
20 th St / N St	6.5	A	15.7	B	9.3	A	20.5	C
20 th St / M St NW	13.8	B	17.2	B	18.5	B	18.4	B
20 th St / L St	12.1	B	11.7	B	17.1	B	18.5	B

Table 21: Recommended Alternative Traffic Analysis Results for 2040 Conditions

Intersection Location	AM Peak Hour				PM Peak Hour			
	2040 No Build		2040 Build		2040 No Build		2040 Build	
	Delay	LOS	Delay	LOS	Delay	LOS	Delay	LOS
20 th St / K St	12.1	B	17.2	B	11.5	B	23.3	C
20 th St / I St	9.2	A	26.2	C	13.5	B	20	B
20 th St / Pennsylvania Ave	13.4	B	26.4	C	22.1	C	16.9	B
20 th St / H St	10.4	B	17.9	B	10.9	B	12.3	B
20 th St / G St	6.6	A	61.1	E	10.7	B	21.9	C
20 th St / F St	6.1	A	9.6	A	8.1	A	6	A
21 st St / G St	7.9	A	9.5	A	7.8	A	8.6	A
21 st St / F St	8.8	A	4.9	A	6.2	A	23.1	C
21 st St / E St	17.1	B	9.2	A	15.2	B	16.8	B
21 st St / Virginia Ave	10.1	B	19.2	B	10.8	B	22.6	C
21 st St / C St	7.5	A	35.1	D	4.5	A	341.7	F
21 st St / Constitution Ave	10.6	B	54.2	D	120.1	F	166.9	F

The analysis of existing parking demand demonstrated that 20th Street did not have any blocks with parking demand greater than 80 percent occupancy, resulting in a lesser impact from removal of parking along the corridor. This is compared to 21st Street where a majority of the corridor experiences heavy parking demand (greater than 80 percent occupancy) during the middle of the day, and approximately one third of the corridor experiences heavy parking demand throughout the day. 22nd Street experiences heavy parking demand as well, although not as much as 21st Street. Approximately half the corridor experiences heavy parking demand during the middle of the day, and about one quarter of the corridor experiences heavy parking demand in the evening.

Between the three design alternatives, 20th Street removed the least number of parking spaces and minimized impacts to residential parking. **Table 22** below summarizes the proposed parking changes under the recommended alternative on 20th Street and 21st Street.

Table 22: Recommended Alternative Parking Impacts

	Existing	Proposed
Total Parking	303 spaces	About 106 (-197 spaces)
Residential Permit Spaces (RPP)	4 spaces	4 (-0 spaces)
Embassy Spaces	0 spaces	0 (-0 spaces)
Taxi or Loading	29 spaces	8 (-21 spaces)
All-Day Metered	63 spaces	About 43 (-20 spaces)
AM or PM Peak Restricted	160 spaces	About 41 (-119 spaces)
No Parking 7am-6:30pm	47 spaces	About 10 (-37 spaces)

Feedback from the Public and Stakeholders

The recommended alternative was presented to the public at Public Meeting #3, during which attendees provided written comments through the comment form and by placing comments on the roll plots using Post-It notes. The meeting also provided an opportunity for public testimony so that attendees could offer their feedback directly to DDOT staff.

Overall, participants expressed an appreciation for the compromise to select 20th St and 21st St as the recommended alternative. There was recognition from bicyclists that the decision was a reasonable compromise once DDOT ensured connections to R St and Constitution Ave would be a part of subsequent design phases. Many comments noted the project schedule and encouraged DDOT to explore opportunities to expedite the implementation of the two-way protected bike lane.

Common concerns amongst participants included:

- *20th St between New Hampshire Ave and Connecticut Ave* – Many participants expressed concerns over the interaction with the Dupont Circle Farmers Market. Additional challenges in this area include the narrower right-of-way, bus stop at Q St, and heavy pedestrian traffic from the metro station. FRESHFARM did issue a statement of support and a commitment to working with DDOT staff during the public testimony.

- *Connecting 20th St and 21st St safely* – Many participants noted the need for strong wayfinding guidance and additional consideration for the intersection design at F St and G St to facilitate the connection.

DDOT staff noted that these concerns would be prioritized and addressed as the project design continues towards implementation.

Next Steps

The recommended alternative will continue into the next phase of work to complete its design and environmental documentation prior to construction in 2021. Working towards project implementation, areas of focus for DDOT include design, analysis, and coordination. Each stage will include traffic analysis, design plans, and community engagement.

The 30% and 100% design phases will refine the recommended alternative for full implementation. In coordination with this project, DDOT will develop concept designs for one-way protected bike lanes on F St and G St between 17th St and Virginia Ave. These bike lanes are recommended in *moveDC* and will connect the two 20th St and 21st St components of the recommended alternative. The next design phase will also require coordination with the Pennsylvania Avenue Streetscape Project, as well as the Connecticut Avenue Deck Over and Streetscape Project in order to ensure a completed connection to the R St bike lane at the northern end of the corridor.

Subsequent design phases will be coupled with additional parking, loading, and traffic analysis. The parking impact analysis should be updated with each new design phase. DDOT noted that a pick-up and drop-off needs assessment will be conducted as part of the next project phase and that alternate loading zone locations will be identified to accommodate the project. Between L St NW and N St NW on 20th St DDOT will focus on pick-up and drop-off as they anticipate a new daycare facility in close proximity to the existing MedStar complex.

This phase of work only analyzed intersection-level vehicular delay at signalized intersections. Additional traffic analysis is needed to understand delay impacts to all intersections and to analyze travel time impacts due to the proposed project. High-level cost estimates based on the current design anticipate projects costs could range between \$1 Million to \$3 Million. These estimates assume a 25 percent contingency and include planning and design costs, and the full details can be found in **Appendix G**. The final design phase will include detailed cost estimates as part of its scope of work.

Engaging with key stakeholders and the public will be a continuous effort on this project. Key stakeholders to be included in ongoing coordination include:

- Federal Reserve Board (FRB)
- FRESHFARM, Dupont Farmers Market
- US Department of State

- National Academy of Sciences
- WMATA
- Adjacent Residents
- Adjacent Businesses
- General Public

DDOT will continue to coordinate with FRB and US Department of State to minimize conflicts between the loading activity at the office buildings and the bike lanes. Coordination with WMATA will be key to successfully relocating and consolidated bus stops on 20th Street, particularly at the New Hampshire Ave intersection and at the Q St intersection which is central to the Dupont Farmer's Market Sunday operations. DDOT's coordination with FRESHFARM will seek to identify solutions that work for both the Farmers Market and bike lanes as they relate to barrier options and bike operations during market hours.

As the design for F St and G St bike lanes gets underway, DDOT will engage with residents along those streets to seek input on design alternatives. Soliciting input from the general public as design progresses for the recommended alternative will support a streamlined implementation process for DDOT and will be a focus area for this project's next steps.